

## **EXHIBIT C**

**IN THE UNITED STATES DISTRICT COURT  
FOR THE EASTERN DISTRICT OF PENNSYLVANIA**

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**AGERE SYSTEMS, INC., CYTEC  
INDUSTRIES INC., FORD MOTOR  
COMPANY, SPS TECHNOLOGIES,  
LLC and TI AUTOMOTIVE SYSTEMS  
LLC,**

**Plaintiff,**

**v.**

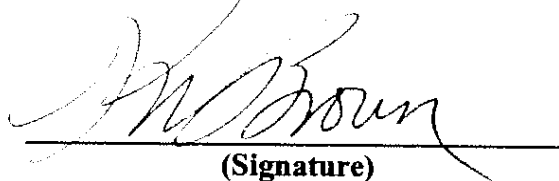
**ADVANCED ENVIRONMENTAL  
TECHNOLOGY CORPORATION, et al.,**

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**Defendants.**

**Civil Action No.  
02-cv-3830 (LDD)**

**Expert Witness Report of  
Kirk W. Brown, Ph.D,**



(Signature)

**September 29, 2006**

I. Expert Qualifications

1. I am a Principal Consultant with the firm of SI Group, LP ("SIG"). SIG's offices are located at 1701 Southwest Parkway, Suite 100, College Station, Texas.

2. My educational background includes a Bachelor of Science degree in Agronomy from Delaware Valley College (1962), a Masters of Science degree in Agronomy/Plant Physiology from Cornell University (1964), and a Doctor of Philosophy degree in Agronomy from the University of Nebraska (1969).

3. From 1970 through 2001, I was a member of the faculty at Texas A&M University and currently serve as *Professor Emeritus* in the Soil and Crop Sciences Department, Texas A&M University, College Station, Texas.

4. During my tenure at Texas A&M, I conducted extensive research including numerous research projects for the U.S. Environmental Protection Agency ("USEPA") on the fate and transport of contaminants in the environment including Resource Conservation and Recovery Act ("RCRA") hazardous wastes and Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") hazardous substances. As a result of my research efforts, I have authored or co-authored over 190 peer-reviewed, scientific publications.

Research projects, which I conducted included investigations of the movement of hazardous substances through geomembrane landfill liners and caps and the underlying soil, the fate and movement of hazardous metals in the environment and the land treatment of wastes. My research was instrumental in development of the USEPA regulations which specify the design of hazardous and municipal waste landfills, and in the banning of liquid and untreated wastes from disposal in landfills.

5. I have served on technical advisory panels to the USEPA, US Congressional

Office of Technology Assessment, National Science Foundation, and the National Academy of Science. Significant reports resulting from these committee assignments include, Groundwater and Soil Cleanup, Improving Management of Persistent Contaminants (1999); Ranking Hazardous Waste Sites (1994); Coming Clean, Superfund Problems Can be Solved (1989); and Superfund Strategy (1985).

6. I was the primary author of two publications for the USEPA entitled Hazardous Waste Land Treatment (1983) and Characteristics of Hazardous Waste Streams (1982). Both of these texts deal with the composition, handling, and disposal of hazardous substances in industrial waste streams.

7. I was formerly a member of the American Society of Agronomy (1970-2001), Soil Science Society of America (1970-2001), American Chemical Society (1970-2001), and the International Society of Soil Science (1970-2001). Additionally, I served on the editorial board for Environmental Engineering Science, formerly known as Hazardous Waste and Hazardous Materials from 1989 through 2001.

8. Some of my other committee assignments include the following:

- National Academy of Sciences, National Research Council Committee on Environmental Technologies Subcommittee on Landfills (1995-1998).
- USEPA Review for Risk Assessment for Petroleum Industry Hazardous Waste Listing Determination (Sept 1995).
- Environmental Geosciences Advisory Committee of the American Geological Institute representing the Soil Science Society of America (1993-2000).
- National Academy of Sciences (NRC) Committee on Remedial Action Priorities for Hazardous Waste Sites (1991-1994).

- USEPA Hazardous Waste Center Review Panel (1988).
- National Science Foundation, Environmental Engineering Div., Review Panel (1987-1995).
- Advisory Panel to U.S. Congressional Office of Technology Assessment (OTA) on An Assessment of the Effectiveness of the USEPA in Identifying, Prioritizing and Cleaning Up Hazardous Waste Sites (1987-1995).
- Organizing Committee for SSSA Workshop on Utilization, Treatment and Disposal of Waste on Land (1985).
- Panel to Write Research Needs for Hazardous Wastes Treatment and Disposal for National Science Foundation. Drexel University, PA (1986).
- USEPA Technical Advisory Panel on the Adequacy of Ground Water Monitoring at Hazardous Waste Landfills (1985).
- USEPA Panel to Review the Acceptability of Landfill Disposal of Sewage Sludge (1984).
- Office of Water Regulations and Standards Committee on Municipal Sludge Landfilling to Advise USEPA on the Pollutants which should be Regulated for Various Disposal Options and the Methods or Procedures to be Used for Regulating such Pollutants (1984).
- Advisory Panel to U.S. Congressional Office of Technology Assessment (OTA) to Determine the Effectiveness of Current Programs to Clean Up Uncontrolled Hazardous Waste Sites (1983-84).
- USEPA Science Review Panel for Environmental Engineering Research Grants (1982-1998).

- United States Environmental Protection Agency Land Treatment Task Force (1981-1985).

9. I have been a consultant in the field of environmental science and engineering for the past 25 years. I founded K. W. Brown and Associates, Inc., and served as President from 1980 until 1991. I was employed as a Principal Consultant with K. W. Brown Environmental Services from 1991 until 1999 and with SIG since 2000. Consulting activities have included consultations on the cleanup and disposal of wastes, the impacts of hazardous waste on the environment, the design of hazardous waste landfills and solid waste management units, and the fate and mobility of hazardous substances in the soil, groundwater, and air.

10. As part of my work for the USEPA in the late 1970's and early 1980's, I conducted an extensive survey of industrial and manufacturing facilities. Having reviewed and studied the industrial processes, the waste streams generated, and the disposal practices by these facilities, I have expertise in the characteristics of the industrial waste streams generated by parties involved in this matter. I also have experience in the remedial design for hazardous waste disposal sites, remediation/reclamation of waste contaminated soil and groundwater, and the design of hazardous waste landfills and solid waste management units.

11. I have qualified and given testimony as an expert witness in civil cases in federal and state courts, regulatory hearings, and enforcement actions pertaining to hazardous wastes, heavy metal contamination, the fate and transport of inorganic chemicals and other contaminants in environmental media, and remediation of contaminated sites, among other issues. I have offered opinions related to the fate and transport and/or clean up of organic chemical and metals at several Superfund sites.

12. In the published opinion in the matter entitled *B.F. Goodrich v. Bertowski*, 99 F.3d 505, 525 (2d Cir. 1996), the Second Circuit commented on my qualifications in the field of environmental remediation as follows: "... it is difficult for us to imagine an expert with more experience and knowledge in the hazardous substances field than Dr. Brown."

13. In the published opinion in the matter entitled *Interfaith Community Organization v. Honeywell International, Inc.*, 263 F. Supp. 2d 796, 810 (D.N.J. 2003), *aff'd* 399 F.3d 248 (3d Cir. 2005), the district court commented on my qualifications and trial testimony as follows:

I found Dr. Brown to be most believable and credible and I therefore afforded his testimony the greatest weight. Not only was he a knowledgeable and believable witness, but the subject of his testimony was perhaps the most significant in assisting the Court regarding the appropriate remediation at the Site. Dr. Brown was an excellent witness.

## II. Curriculum Vitae, Previous Expert Testimony and Publications

14. A copy of my current curriculum vitae, a list of cases in which I have given expert testimony and a list of the publications authored/co-authored by me, are annexed hereto as Exhibits A, B and C, respectively.

## III. Engagement Compensation

15. I am being compensated for my work in this case at an hourly rate of \$200 per hour for non-testimony time and \$250 per hour for testimony time. SI Group, LP has been retained to work under my direction and assist me in gathering information for the preparation of this report. The rate of compensation for members of SIG ranges from \$73 to \$120 per hour.

## IV. Scope of Assignment

16. I have been retained by counsel for Handy & Harman Tube Company, Inc. ("Handy & Harman") to review information and data relating to (1) waste generation at Handy & Harman's Norristown, Pennsylvania facility (the "Handy & Harman Facility") and (2) the

Boarhead Farm Superfund Site (the "Site") and to provide my professional opinions based on certain assumptions (described below) with respect to the following:

- the impact, if any, that certain wastes generated at the Handy & Harman Facility, and alleged to have been transported to and disposed of at the Site during the period from 1969 to 1977, had, have, or will have on the remediation of the Site.

V. Data and Other Information Considered

17. I have reviewed documents provided by counsel and gathered independently from reputable sources. Specific documents, data, and/or other information that I have considered in forming my opinions in this case are listed in Exhibit D hereto. My opinions are also based on my education and experience as described herein, relevant scientific journal articles or textbooks, and/or observations made during my visit to the Site. Additionally, as discovery is ongoing in this case, I reserve the right to base my opinions on additional documents or information that may be produced by any party and/or their consultants following the submittal of this report.

VI. Familiarity with the Site

18. I conducted a visit of the Site on September 18, 2006. During this visit, I observed, among other things, the locations associated with the burial of intact drums and the locations of the soil and groundwater "hot spots".

VII. Purpose of Report

19. This report and the opinions set forth herein, as well as any testimony I may give in depositions in this matter or at the time of trial, is designed to assist the court in making determinations under 42 U.S.C. § 9613(f) as part of the allocation portion of the proceedings in this case.

VIII. Assumptions

20. The opinions set forth in this Report are based upon the following assumptions:

a. Plaintiffs can establish under the applicable legal standards Handy & Harman's nexus to the Boarhead Farms Superfund Site;

b. The DeRewal Chemical Company invoice dated February 1973 is found to be an admissible piece of evidence under the applicable legal standards; and

c. The facts relating to Handy & Harman testified to by Manfred DeRewal, Sr., Manfred DeRewal, Jr., Bruce DeRewal, and John Barsum in their respective depositions in this litigation are presented at trial and are found to be admissible and credible.

21. Nothing in this report or in any of my opinions is, or should be construed as, an admission by Handy & Harman of any of the assumptions set forth above.

IX. Expert Opinions

22. This section of my report will present my professional opinions and the basis of those opinions. As noted above, each of my opinions is based upon the Assumptions set forth in Paragraph 20 above.

**A. Opinions**

23. It is my professional opinion that the chemical fingerprint of the wastes contained in the drums that were removed from the Site includes chemical compounds and metals that were not used at the Handy & Harman Facility and therefore, the drummed wastes buried at the Site could not be attributed to the Handy & Harman Facility.

24. It is my professional opinion that the contaminated soils and groundwater associated with the "hot spots" at the Site containing benzene and PCE with a mixture of other

chlorinated volatile organic compounds were not caused by waste generated by the Handy & Harman Facility.

25. If the Handy & Harman Facility had disposed of wastes, such as metals, spent solvents, and spent acids at the Site, these wastes would be indistinguishable from the waste contributed by other parties. Further, if Handy & Harman's waste had been disposed of at the Site, waste attributed solely to the Handy & Harman Facility would not be distinguishable from the wastes identified in the soils and shallow groundwater at the Site.

26. In my professional opinion, the contribution from the Handy & Harman Facility, if any, to the contamination due to bulk waste disposal at the Site would be at most, de minimis (USEPA, 1995d; USEPA, 1993b).

27. In my professional opinion, the contribution from the Handy & Harman Facility, if any, to the contamination due to the drummed waste disposal at the Site would be at most, de minimis (USEPA, 1995d; USEPA, 1993b).

28. In my professional opinion, the contribution from the Handy & Harman Facility, if any, to the contamination due to the total volume of waste disposed of at the Site would be at most, de minimis (USEPA, 1995d; USEPA, 1993b).

29. My opinions as set forth above are within a reasonable degree of scientific certainty.

**B. Basis of Opinion**

*i. Handy & Harman Facility*

30. During the period of interest, the Handy & Harman Facility manufactured small diameter, hollow tubing from stainless steel, carbon steel, and nickel-iron alloys. For this manufacturing process, raw stock materials were precision drawn through tubing dies and

annealed in an on-site furnace (Handy & Harman, 2004a). The intermediate products were cleaned in a degreasing vat to remove any oil or impurities and dried prior to annealing (Handy & Harman, 2004a). The finished tubing products were acid treated in a pickling bath, polished, and cut to finish specifications (Handy & Harman, 2004a).

31. As a result of the manufacturing process, the following waste streams were produced at the Handy & Harman Facility:

- a. Waste raw materials, including Nickel-based Inconel steel (Curran, 2004, pg. 12), 300 and 400 series stainless steel (Curran, 2004, pg. 12-13), 1010 carbon-iron steel (Curran, 2004, pg. 13), nickel-iron alloy composed of approximately 50% nickel and 50% iron (Curran, 2004, pg. 39), and welding metals used for the manufacture of hypodermic needles (Curran, 2004, pg. 38);
- b. Polisher wastes composed of water, grit, and metals from the stainless steel products (Curran, 2004, pg. 71);
- c. Spent Acids, including waste mixtures of water with sulfuric, nitric, hydrochloric, and hydrofluoric acids (Curran, 2004, pg. 21; Curran, 2004, pg. 31);
- d. Bottom sludges from the degreaser (Curran, 2004, pg. 56-57);
- e. Spent cleaning solvents consisting of acetone and methyl ethyl ketone (Curran, 2004, pg. 48-49; Curran, 2004, pg. 51-52);
- f. Used oil and lubricants (Curran, 2004, pg. 73);

- g. An industrial waste solution containing wash water, oil and grease, dirt, grime, etc. generated during the plant shut-down cleaning operations (Curran, 2004, pg. 54-55); and
- h. Office wastes/plant trash (Handy & Harman, 2004a).

32. By virtue of the processes conducted at the Handy & Harman Facility, Handy & Harman did not use the following chemical compounds:

- a. Benzene;
- b. Perchloroethylene ("PCE");
- c. Carbon tetrachloride ("CCl<sub>4</sub>");
- d. Cyanide ("CN");
- e. Dinitrotoluene ("DNT");
- f. Nitrobenzene ("NB"); and
- g. Cadmium<sup>1</sup>.

These chemical constituents would not have been present in any of the waste streams generated at the Handy & Harman Facility.

33. The following metals were not associated with the manufacturing processes at the Handy & Harman Facility and therefore, would only have been found in miniscule quantities, if any, in the waste streams generated at the Handy & Harman Facility:

- a. Arsenic;
- b. Selenium;
- c. Silver;

1. In alloys of stainless steel, carbon steel and nickel-iron, cadmium serves as a sacrificial anode and enhances corrosion of the metal. For this reason, cadmium is excluded as a component of stainless steel and would not be present as a component of the waste from the Handy & Harman Facility (Sedriks, 1996; Dillon, 1995).

- d. Lead; and
- e. Mercury.

34. The Handy & Harman Facility did not use paints or adhesives in the manufacture of tubing and would not have generated paint wastes, spent resins, or waste polymers which were the wastes found in the drums discovered and removed during the response actions performed for the remediation of Operable Unit OU-2 (Brown and Caldwell, 2004c).

*ii. Bulk Waste*

35. Based upon the data and information which I have reviewed, spent acid was the only waste stream that was generated at the Handy & Harman Facility and ultimately removed, transported and disposed of as bulk waste. The only suggestion in the data and information, which I have reviewed that the spent acid bulk waste generated at the Handy & Harman Facility was transported to and disposed of at the Site was the deposition testimony of Manfred DeRewal, Jr. ("Freddy DeRewal"). During his deposition, Freddy DeRewal stated that he picked up bulk waste (without specifying the type of waste) on one occasion from a facility outside of Norristown that he believed was the Handy & Harman Facility (DeRewal, F., 2003a, pg. 119). The former and current employees of the Handy & Harman Facility who gave deposition testimony uniformly testified that (1) the bulk waste at the Handy & Harman Facility was spent acid; (2) the spent acid bulk waste was hauled from the Handy & Harman Facility by Waste Conversion Systems as early as 1965-1970 (Curran, 2004, pg. 16-17); and (3) Waste Conversion Systems had a number of successors, each of whom continued to haul spent acid bulk waste from the Handy & Harman Facility continuously from the 1970s through the present (Handy & Harman, 2004a).

36. In all of the information that I have reviewed, there is no evidence of any trip tickets or invoices related to the transport and disposal of bulk waste liquids from the Handy & Harman Facility by DeRewal Chemical Company.

37. In the unlikely event that Freddy DeRewal picked up and disposed of one load of bulk waste liquids, the quantity of liquids that could have been disposed from the Handy & Harman Facility was insignificant when compared to the total volume of bulk liquids disposed of at the Site. According to the deposition testimony of Freddy DeRewal (DeRewal, F., 2003a, p. 33-34),

"In the very beginning we weren't actually that into it big in the waste hauling business. I mean, we did some runs, it didn't actually start -- like I'm saying, when we started really getting into it we were doing like maybe 30 loads of bulk a week, bulk tankers. And in the beginning we might have been doing anywhere from five to eight to ten, ten loads."

38. At a rate of 8 to 10 loads per week for a period of one and one half years (1973-1974) and a rate of 30 loads per week during the last two years of operations (1975-1977), the approximate total quantity of waste as Freddy DeRewal described would be 3,600 tanker loads. Had one load of bulk liquids from Handy and Harman been disposed at the site, one load of bulk liquids out of approximately 3600 loads is an insignificant, de minimis volume of waste that could have been disposed of at the Site.

39. Further, spent acids did not drive the remedy at the Site (USEPA, 1998).

iii. *Drummed Waste*

40. In the information and data that I have reviewed, the only suggestion that drummed waste generated at the Handy & Harman Facility was transported by DeRewal Chemical Company was contained in a single invoice dated February 1973 (Curran, 2004, Deposition Exhibit 3) and certain statements by Bruce DeRewal (DeRewal, B., 2003).

41. The invoice from DeRewal Chemical Company to Handy & Harman dated February 1973 does not provide evidence of disposal of hazardous waste at the Site. This invoice indicates the delivery of empty drums to the Handy & Harman Facility and the transport of drums containing "Industrial Waste Solution". The invoice does not specify a "shipped to" location nor does it in any way indicate the location for ultimate disposal of the industrial waste solution (Curran, 2004, Deposition Exhibit 3).

42. "Industrial Waste Solution" was described in the deposition testimony of Thomas Curran (2003, p. 55) as "That sort of combination most of it was water, it also has like some just sludge from around the machines in it and that was all taken off." Additional information provided by current Handy & Harman employees knowledgeable of the cleaning process during plant shut-down indicated that the industrial waste solution consisted of wash water that was used to remove residual grease and oil from the drawing machines (Coates, 2006).

43. Based on the description of the cleaning process during the plant shut-down, the wastewater generated as the industrial waste solution was non-hazardous.

44. Based on my experience with and knowledge of waste disposal methods utilized during the relevant period (1969-1977), when non-hazardous wastewater was placed in drums for disposal, the standard practice for disposal companies was to empty the drums into a public sewer system or publicly owned treatment works and recycle the metal drums for reuse. The disposal of waste liquids into the Philadelphia storm sewer system was clearly used by DeRewal Chemical Company in their operation of the Ontario Street and Wissinoming facilities (DeRewal, B., 2003, pg. 47).

45. In his deposition testimony, Bruce DeRewal testified that he hauled drummed wastes from an undisclosed facility in the Norristown area on an unspecified number of

occasions. The drummed wastes were hauled to both the Ontario Street facility and the Site with an estimated 25% or less of the drums taken to the Site. For the drums hauled to the Site, Mr. DeRewal did not provide any information regarding the disposal of the drums.

46. During his testimony, Bruce DeRewal did not specifically recall picking up wastes from the Handy & Harman Facility (DeRewal, B., 2003, pg. 42),

- Q. Okay, fair enough. Did you ever pick up any waste from a company called Handy & Harman?
- A. Not that I recollect, no.
- Q. Do you remember picking up any waste from a company outside of Norristown or in the Norristown area?
- A. Yeah, but I believe that was Standard Pressed Steel, wasn't it?

47. Further in his deposition, Bruce DeRewal testified that he picked up wastes from a facility outside of Norristown, but was unable to recall how many times he might have gone to the facility (DeRewal, B., 2003, pg. 50).

- Q. The Norristown, the outside Norristown place that we talked about a few minutes ago, I don't remember if I asked you how many times you went there.
- A. I don't recall. Not that many.
- Q. By "not that many", we mean less than ten?
- A. Yes.
- Q. Less than five?
- A. Let's say less than ten, let's keep it at ten.
- R. You're comfortable with less than ten?
- A. Yeah, I think.

48. In his deposition, Bruce DeRewal stated that he picked up approximately 20 drums of wastes in a box truck each time he visited the facility outside of Norristown, but he was unable to recall the number of drums that would have been hauled to the Site and he provided no information regarding the disposal of drums at the Site (DeRewal, B., 2003, pg 55-57).

- Q. How many drums do you think you put in the box truck?
- A. About 20.
- Q. On the times that you went to that facility and picked up drums, where did those drums go for disposal?

A. They went down to, they would go down to Ontario Street or I would take them back to the farm.  
Q. Okay. Any other choices between Ontario Street and the farm?  
A. No, those were the only two places.  
Q. On the occasions that you went to that facility that we're talking about to pick up drums, how many times did you take them back to the farm?  
A. I don't recall.  
Q. Sitting here today, is it, can you come up with a reasonable approximation of whether it was half the time or a quarter of the time?  
A. Maybe a quarter or less. Most of the time it was in Philly.  
Q. Okay. Quarter or less went back to the Boarhead site --  
A. Yes.  
Q. -- to be disposed of?  
A. I don't know. I took the truck back and dropped it.  
Q. You took the truck back and dropped it and it had the drums in it?  
A. Yes.  
Q. You never saw the drums leave any other way?  
A. No.

49. Further, when asked in his deposition, Bruce DeRewal stated that he did not know what type of waste was contained in the drums he removed from the facility outside of Norristown (B. DeRewal, 2003, pg. 135).

Q. Did you know what type of waste was contained in the drummed waste that you picked up from the facility located outside of Norristown?  
MR. HARRIS: Objection.  
THE WITNESS: No.

50. Taking Mr. DeRewal's testimony as an accurate representation of the waste hauling and disposal operations that could have transpired, the maximum number of drums that possibly could have been transported from the Handy & Harman Facility (assuming that the facility "outside of Norristown" was the Handy & Harman Facility), and brought to the Site would have been 50 drums<sup>2</sup>.

2. Again, there is no documentary or testimonial evidence that I have seen which would indicate that drums from the Handy & Harman Facility were disposed of at the Site.

51. Based on the Federal On-Scene Coordinator's Report (USEPA, 1993a) and the Remedial Construction Report OU-2 (Brown and Caldwell, 2004c), over 2500 drums were removed from the Site. In the unlikely event that 50 drums from the Handy & Harman Facility could have been disposed of at the Site, the maximum volumetric contribution of drummed wastes from Handy & Harman would be less than 2 %, if any.

*iv. Composition of Wastes*

52. In the deposition of Thomas Curran (2004), Mr. Curran described the waste streams at the Handy & Harman Facility that were placed in drums for disposal. These wastes included:

- a. Polisher wastes;
- b. Bottom sludges from the degreaser;
- c. Spent acetone and methyl ethyl ketone cleaning solvents;
- d. Used machine oils; and
- e. Industrial waste solution.

53. The polisher wastes as described by Mr. Curran would have contained water with small amounts of grit and metal particulates of stainless steel and the other raw materials used at the Handy & Harman Facility (Curran, 2004, pg. 71-72). The polisher wastes were generated in small quantities and were combined with the waste stored in a drum at the individual machine (Curran, 2004, pg. 73). The drums of polisher wastes were removed from the Handy & Harman Facility by Delaware Trucking (Curran, 2004, pg. 74-76). Delaware Trucking has no relationship with the Site.

54. Handy & Harman used a degreaser at the Handy & Harman Facility. Trichloroethylene ("TCE") was used in the degreaser to clean the tubing during the

manufacturing process (Handy & Harman, 2004a). The Handy & Harman Facility did not use benzene or PCE.

55. The bottom sludges from the degreaser were described by Mr. Curran as solid material which had to be removed from the bottom of the degreaser by shovel (Curran, 2004, pg. 56). Mr. Curran indicated that the removal of sludge from the degreaser was an infrequent process that generated only a small volume of waste (Curran, 2004, pg. 51-52).

Q. Can you estimate whether it was more than 20 or less than 20? 25 drums?

MR. AGNELLO: Again don't guess.

THE WITNESS: I can't because I can remember witnessing soon after we had it dried out and one, during one of our periods and I was astounded at how little was in the bottom. In fact, I was quite annoyed that we were doing it when I saw what happened. So I can only assume that they were guessing at when it needed to be done. It was not frequent, though, what I would call frequent.

Mr. Curran further stated that Chemcene was used by Handy & Harman for the transport and reprocessing of the degreaser sludges as early as he could recall (Curran, 2004, pg. 58).

56. If drums containing the degreaser sludges from the Handy & Harman Facility had been disposed of at the Site, the wastes would have been solids with minimal free liquid TCE. The TCE incorporated in the degreaser sludges was strongly partitioned into the sludge and not present as a free-flowing liquid. The minimal volume of free liquid TCE in the drums containing the degreaser sludge would not have driven the remedy for the Site.

57. In his deposition, Mr. Curran (Curran, 2004, pg. 48-49) described the use of acetone and methyl ethyl ketone as cleaning solvents for tools. These cleaning solvents were used in small quantities and any spent solvent "would have been drummed, if they had not evaporated" (Curran, 2004, pg. 49). The volume of waste generated from these cleaning

operations would have been minimal due to the limited volume of solvents used and the loss due to evaporation.

58. Oils such as 10W-30 and 5W-30 were used as lubricants and coolants for some of the machines and furnaces at the Handy & Harman Facility (Curran, 2004, pg. 73). Mr. Curran indicated that these oils were changed on routine maintenance intervals with the spent oil collected in 55 gallon drums and sold for recycling (Curran, 2004, pg 73). Additional evidence provided by Handy & Harman indicated that waste lubricants were removed from the facility by Lightman Drum, Chemcene, and Delaware Container (Handy & Harman, 2004a).

59. As previously discussed, the industrial waste solution would have consisted of wash water with trace amounts of residual grease and oil removed from the drawing machines (Curran, 2004, p. 55). The waste generated as the industrial waste solution was non-hazardous and would have contained only miniscule quantities, if any, of any hazardous substances (i.e., those that may have been contained in the raw materials and/or picked up with the grease and lubricants used with the drawing machines).

60. Based on my review of information and data listed in Exhibit D, the only waste stream at the Handy & Harman Facility that would have been produced in sufficient quantities to make up a load of 20 drums was the industrial waste solution, which would have been classified as non-hazardous wastewater.

61. The Federal On-Scene Coordinator's Report (USEPA, 1993a) provided a chemical profile of the wastes contained in the drums removed from the Site. As shown in Table 1, the analysis of each group of drums indicated the presence of one or more hazardous substances in the waste that were not constituents of the wastes generated by the Handy & Harman Facility. Further, the physical state of the waste (i.e., solid or liquid) reported for the

drums removed from the Site did not match the physical characteristics of the degreaser sludge generated at the Handy & Harman Facility. In all cases, the characteristic profile for each group of drums removed did not match the chemical composition of the waste streams from the Handy & Harman Facility.

62. As part of the Remedial Investigation of the Site, surface and subsurface soil samples were collected from a sampling grid and shallow groundwater samples were collected from the monitoring well network at the Site (CH2M Hill, 1997a). The analytical results from these sampling activities conducted in 1993, indicated elevated concentrations of contaminants at three areas of concern (the "Hot Spots"). Benzene and TCE were identified as the principle contaminants of concern based on the highest concentrations. PCE, and 1,1,1-trichloroethane ("1,1,1-TCA") along with their biodegradation products, *cis*-1,2-dichloroethylene ("*cis*-1,2-DCE"), 1,2-dichloroethane ("1,2-DCA"), and vinyl chloride ("VC"), among others were reported as secondary contaminants of concern with elevated concentrations.

63. As stated in the Record of Decision for the Site (USEPA, 1998), "Extremely high levels of TCE and high levels of PCE and 1,1,1-TCA were detected in the soil following drum removal" at Hot Spot 1 located within the wetland area at the north end of the Site. Methyl isobutyl ketone ("MiBK") was also reported to have elevated concentrations in the soils at Hot Spot 1 (CH2M Hill, 1997a). Shallow groundwater monitoring wells in the area of Hot Spot 1 included monitoring wells MW-10, MW-17, and MW-23. Groundwater samples collected from these wells contained concentrations of contaminants of concern in excess of the Maximum Contaminant Levels ("MCLs") and Risk Based Concentrations ("RBCs") for the following compounds (CH2M Hill, 1997a):

- chromium;
- lead;

- nickel;
- thallium;
- MiBK;
- 1,1,1-TCA;
- 1,1,2-trichloroethylene ("1,1,2-TCA");
- 1,1-dichloroethylene ("1,1-DCE");
- 1,3-dichlorobenzene;
- 1,2-dichloroethane ("1,2-DCA");
- 1,2-dichloroethylene ("1,2-DCE");
- 1,2-dichloropropane ("1,2-DCP");
- benzene;
- *cis*-1,2-DCE;
- PCE;
- *trans*-1,2-dichloroethylene ("1,2-DCE");
- TCE; and
- VC.

64. Of the chemical compounds found in the soils and groundwater of Hot Spot 1 at concentrations in excess of the Drinking Water MCLs and RBCs, only chromium, nickel, and TCE would have been constituents in the wastes generated by the Handy & Harman Facility. As a group, the contaminants of concern in the soil and groundwater at Hot Spot 1 could not have come from the Handy & Harman waste.

65. In the Remedial Investigation, soil samples collected from the area south of the farmhouse (designated as Hot Spot 2) contained elevated concentrations of 1,1,1-TCA; MiBK; *cis*-1,2-DCE; ethylbenzene; xylenes; PCE; toluene; and TCE. Shallow groundwater monitoring wells in the area of Hot Spot 2 included monitoring wells MW-14, MW-16, MW-20, and MW-21. Groundwater samples collected from these wells contained concentrations of contaminants of concern in excess of the Drinking Water MCLs and RBCs for the following compounds (CH2M Hill, 1997a):

- beryllium,
- cadmium,
- chromium,
- lead,

- manganese,
- nickel,
- bhc-alpha,
- bhc-gamma,
- nitrobenzene,
- 1,1,1-TCA,
- 1,1,2-TCA,
- 1,1-DCE,
- 1,2-DCA
- MiBK,
- benzene,
- carbon tetrachloride,
- cis-1,2-DCE,
- ethylbenzene,
- methylene chloride,
- PCE,
- TCE, and
- VC

66. Of the chemical compounds found in the soils and groundwater of Hot Spot 2 at concentrations in excess of the Drinking Water MCLs and RBCs, only chromium, manganese, nickel, and TCE would have been constituents in the wastes generated by the Handy & Harman Facility. As a group, the contaminants of concern in the soil and groundwater at Hot Spot 2 could not have come from the Handy & Harman waste.

67. Similarly, for Hot Spot 3, the surface soil contamination identified for the area included MiBK, TCE, and xylenes as contaminants of concern for the impacted soils. Shallow groundwater monitoring wells in the area of Hot Spot 3 included monitoring wells MW-12, MW-13, and MW-15. Groundwater samples collected from these wells contained concentrations of contaminants of concern in excess of the Drinking Water MCLs and RBCs for the following metals (CH2M Hill, 1997a):

- antimony;
- cadmium;
- chromium;
- lead;

- manganese;
- nickel; and
- thallium.

68. Contaminants of concern including 1,2-DCA, 1,2-DCP, benzene, *cis*-1,2-DCE, and VC were detected at concentrations exceeding Drinking Water MCLs in groundwater samples from monitoring well MW-12 only, which was located near of the test pits where a large number of drums were removed.

69. Of the chemical compounds found in the soils and groundwater of Hot Spot 3 at concentrations in excess of the Drinking Water MCLs and RBCs, only chromium, manganese, and nickel would have been constituents in the wastes generated by the Handy & Harman Facility. As a group, the contaminants of concern in the soil and groundwater at Hot Spot 3 could not have come from the Handy & Harman waste.

70. As with the drum wastes, however, the chemical fingerprint of the contaminated soil and groundwater (CH2M Hill, 1997a) does not match the characteristics of the waste generated by the Handy & Harman Facility since the waste found at the Site contains hazardous substances (i.e., benzene, PCE, and MiBK, among others) that were not used at the Handy & Harman Facility and were not constituents of the waste generated by the Handy & Harman Facility. Therefore, the waste associated with the soil and groundwater contamination at the Hot Spots can not be attributed directly to Handy & Harman.

71. Furthermore, if the characteristic profile of the wastes generated by the Handy & Harman Facility is compared with the observed list of contaminants of concern at the Site, it would be impossible to distinguish the wastes generated by the Handy & Harman Facility from the mixture of different waste streams at the Site (See also Paragraph 75-77).

v. *Contributions from Other Parties*

72. I reserve the right to supplement this report upon receipt of the report from Joseph J. Hochreiter, Jr., CGWP, which addresses the Plaintiffs and Settled Defendants' manufacturing operations and waste streams.

73. Based on my review of information and data listed in Exhibit D, Carpenter Technology Corporation, Merit Metals, Flexible Circuits, Southland Corporation, Thomas and Betts, and Rahns Specialty Metals generated wastes containing hazardous substances including chlorinated volatile organic compounds and benzene, among others, and had relationships with DeRewal Chemical Company for transportation and/or disposal of wastes at the Site.

a. Carpenter Technology Corporation operated a manufacturing facility producing specialty steel products in Reading, Pennsylvania (DeRewal and Carpenter, 1973a). Waste streams associated with the manufacturing process at the Carpenter facility included spent acids, caustics, and heavy sludge that was disposed off-site (The Carpenter Report, 1965). In 1973, Carpenter entered into an agreement with DeRewal Chemical Company to "remove and suitably dispose of waste hydrochloric acid pickling solution from Carpenter's plant in Reading, Pennsylvania" with a minimum waste volume for disposal of 4,000 gallons (DeRewal and Carpenter, 1973a). In his deposition, Freddy DeRewal testified that he hauled between 30 and 40 tanker truck loads of waste from the Carpenter facility with some of the waste transported to the Site (DeRewal, F., 2003a, pg. 135).

- Q. Did they tell you what type of waste it was or where it was coming from?
- A. I don't remember. But I know it was hydrochloric.
- Q. What type of tank did you use to do that type of pick-up?
- A. It was a rubber-lined tanker.
- Q. What did they hold?
- A. 4,000 to 4,300 gallons.

- Q. Did you always leave there full?  
A. Right. They had a meter on it per gallon.  
Q. On how many occasions did you yourself go to Carpenter to pick up waste?  
A. Thirty, 40.  
Q. Over what period of time?  
A. '73 to '75.  
Q. The first time you went to Carpenter, had Ontario opened yet?  
A. No.  
Q. Did any of the Carpenter waste go back to disposal back to the Boarhead Farms site?  
A. Yes, it did.

Additionally, a debit memorandum from Carpenter dated September of 1973 indicates that Carpenter employed DeRewal Chemical Company to unload and clean up leaking waste acid from a tank truck at the Carpenter waste treatment plant in July of 1973 (Carpenter Technology, 1973).

b. Merit Metals operated a non-ferrous metals fabrication facility in Warrington, Pennsylvania. On-site soil contamination at the Warrington facility included cis-1,2-dichloroethane, PCE and TCE along with lead, arsenic and zinc as contaminants of concern. TCE groundwater contamination was also discovered at the facility (RT Environmental Services, 2001a). According to the deposition testimony of Freddy DeRewal (DeRewal, F., 2003a, pg 93), Mr. DeRewal hauled waste from the Merit Metals site on three to four occasions.

- Q. How many times did you personally pick up waste at Merit Metals?  
A. Me personally?  
Q. You personally, yeah.  
A. Three or four times.  
Q. When was the first time you went there in timeframe wise?  
A. '74, '75.

Further, in a letter dated January 26, 1972 from Manfred DeRewal, Sr., DeRewal Chemical Company submitted a proposal for the removal of "waste solution" by

supplying Merit Metals with a 4,000 gallon tanker to be filled with waste solution and removed by DeRewal Chemical Company. (Miller, 1995)

c. Flexible Circuits operated a manufacturing and assembly plant for the production of electronic circuits in Warrington, Pennsylvania during the relevant time frame (Flexible Circuits, 2003). Flexible Circuits is also the successor in interest to the Cherry Hill, New Jersey plant operated by Etched Circuits, which produced electronic circuitry (Flexible Circuits, 2003). Both plants produced numerous wastes including waste acids, spent etchant, and ammonia solutions containing copper, which were transported to the Site. In his deposition, Freddy DeRewal stated that he picked up drums from the Flexible Circuits facility in Warrington and transported the drums to the Site for disposal (DeRewal, F., 2003a, pg. 86-87).

Q. How many loads of drums did you pick up from Flexible and take for disposal at Boarhead?

A. I'd be guessing.

Q. I don't want you to guess. More than one?

A. More than one.

MS. FRIANT: Objection, move to strike.  
He said he'd be guessing.

MR. HARRIS: Well, more than one's easy  
because he said he did it.

BY MR. HARRIS:

Q. How did that drum waste from Flexible get disposed of at Boarhead?

A. Well, a lot of times they were either loaded on the ground and whoever -- I don't know, they either emptied the drums or they apparently put the drums inside the holes. They didn't generate -- I don't know, maybe we went to Flexible maybe once every two months, once every month.

Additionally, invoices from DeRewal Chemical Company to Flexible Circuits document the transport of drummed wastes by DeRewal Chemical Company (BSAI051958; BSAI051960 - BSAI051961).

d. Southland Corporation, as the successor in interest to Ashland Chemical Company, operated a facility in Great Meadows, New Jersey (Southland Corp, 1988a) During the period from 1970 through 1977, the Great Meadows facility manufactured specialty chemicals and generated wastes including spent acids, spent solvents, and flammable liquids, among others, which were disposed of at the Site (Southland, 1988a). According to the testimony of Freddy DeRewal, Ashland wastes were hauled from the Great Meadows facility and disposed at the Site.

- Q. How many loads of Ashland waste did you take to Boarhead Farms for disposal, you personally?
- A. Eight to 15.
- Q. And of those loads that you personally took to Boarhead, where were they disposed of?
- A. They were disposed in front of the office at that time, right in front of the small pond.

Additional information such as Bills of Lading and purchase orders documenting the transport of wastes were provided in Southland Corporation's 104(E) Response Summaries (Southland, 1988a) (BSAI006473 - BSAI006796).

e. Thomas and Betts acquired the Ansley Electronics Corporation, a printed circuit board manufacturer, as a subsidiary in 1966 and collectively maintained operations in two facilities—one in Perkasio, Pennsylvania and another in New Hope, Pennsylvania through the late 1970s. In 1971, Thomas and Betts entered into an agreement with DeRewal Chemical Company to haul and dispose of waste from the Perkasio Facility (Thomas and Betts, 2003a). Wastes generated by the Perkasio facility and transported to the Site by DeRewal Chemical Company included waste etching solution and solvents in 55 gallon drums (Thomas and Betts, 2003a, THOM-0041). According to the testimony of John Bean (Bean,

2003, pg 52), Ansley Electronics had an established relationship with DeRewal Chemical Company through Revere Chemical Company and used the services of DeRewal Chemical Company for the hauling of drummed wastes.

- Q. Do you remember a company called Arthur Ansley?  
A. I remember the name, yes.  
Q. What do you remember about a company with that name?  
A. I think that was one of the outfits that we sold some chromic acid to, but that would have been at the Revere plant and also picked up some of the waste from Ansley, which would have been drum material, 55-gallon drums, I believe.  
Q. Did you personally ever pick up the 55-gallon drum material from an Ansley facility?  
A. I can't say that I did, but more than likely, I did, but that would have been at Revere.

f. Rahns Specialty Metals, Inc. acquired the former Techalloy Company, Inc., facility located in Rahns, Pennsylvania, in May of 1991. During the relevant period from 1969 through 1977, the Techalloy facility was operated as a manufacturing facility for specialty steel products, including wire rod and strip. According to the Rahn's 1992 response to the USEPA, industrial waste streams at the facility included spent pickle liquors, including potassium permanganate, sulfuric acid, nitric acid, nitric hydrofluoric acid, sodium hydroxide and muriatic acid. TCE was used in wire cleaning operations (Foster, 2003). In a letter to the Pennsylvania Department of Environmental Resources on October 12, 1972, Techalloy indicated that DeRewal Chemical Company will be used to haul away acids (Foster, 2003). As stated in his deposition, Freddy DeRewal personally hauled tanker truck loads of waste on three or four occasions from the Techalloy facility to the Site (DeRewal, F., 2003a, pg 131).

- Q. What was the size of the tanker that you took on that run?  
A. 4,000, 4,000 gallons.  
Q. How many times did you pick up waste from Techalloy, you personally?

- A. Three, four.
- Q. Where did you take the waste that you picked up from Techalloy?
- A. Boarhead.
- Q. All of it went there?
- A. Yes.

74. There is abundant documentary and testimonial evidence that wastes generated by Carpenter Technology Corporation, Merit Metals, Flexible Circuits, Southland Corporation, Thomas and Betts, and Rahns Specialty Metals contained hazardous substances and that each of these companies arranged for wastes to be transported to the Site. Based on the information and data that I reviewed, the wastes from one or more of these companies, if not all, would have contained the following hazardous substances:

- a. TCE and other chlorinated volatile organic compounds;
- b. Acetone;
- c. Methyl ethyl ketone;
- d. Nickel;
- e. Chromium; and
- f. Copper.

75. Under the Standard Industrial Classification ("SIC") system both Techalloy and Carpenter Technologies were classified as Primary Metal Industries under SIC Major Group 33 (as having manufactured specialty steel products). Merit Metals would have been classified as a non-ferrous metal fabrication industry (SIC Major Group 34), but would have had similar processes for operations such as cleaning, coating, forming and finishing of the metal products (USEPA, 1995a; USEPA, 1995b). Wastes generated from these generically similar operations would have been similar in type and composition with the exception of scale. Based on the information provided by USEPA through its Sector Notebook Project, the constituents of the waste streams from Merit Metals, Techalloy, and Carpenter Technologies would likely have

included heavy metals, spent pickle liquor, oil and grease, as well as degreasing and cleaning solvents, acids, and alkalis (USEPA, 1995a; USEPA, 1995b).

76. The manufacturing of the printed circuit boards and electronic circuits requires cleaning and coating processes that produce similar wastes to those in the steel and metal fabrication industry (USEPA, 1995c). Common chemicals used during the relevant time period for the cleaning of circuit boards and electronic circuits would have included acetone, TCE, sulfuric, and hydrochloric acid (USEPA, 1995c).

77. During the relevant time period, TCE was the solvent of choice and an industry standard (USEPA, 1995a; USEPA, 1995b; USEPA, 1995c; USEPA, 1982). TCE is an effective solvent that was readily available for a reasonable price. Additionally, TCE is denser than water, which allowed for easy separation when mixed with water, yet it is reasonably volatile to allow for rapid drying of cleaned or degreased parts and equipment without leaving residues. Because of its chemical and physical properties, TCE could be used interchangeably in the production processes of these facilities and as a result, was ubiquitous with industrial processes. Therefore TCE more likely than not, would have been common to each of these companies, Carpenter Technology Corporation, Merit Metals, Flexible Circuits, Southland Corporation, Thomas and Betts, and Rahns Specialty Metals and could not be identified as a fingerprint or marker compound for any particular waste stream.

vi. *Allocation of Contributions*

78. Evidence as to the amount of waste received at the Site is available from the deposition testimony of Freddy DeRewal, covering the bulk waste received, and the number of drums provided in the Federal On-Scene Coordinator's Report (USEPA, 1993) and the Remedial Construction Report OU-2 (Brown and Caldwell, 2004c).

79. Freddy DeRewal testified that for a period of 1-2 years (DeRewal, F., 2003a, pg. 34) approximately 5-10 tanker loads of bulk waste were received per week at the Site (DeRewal, F., 2003a, pg. 34). For the following two years (DeRewal, F., 2003a, pg. 31), receipts at the Site were 30 loads per week (DeRewal, F., 2003a, pg. 34). Tank sizes were given as 4,500 gallons (DeRewal, F., 2003a, pg. 34; pg. 91), 2,700 to 3,000 gallons (DeRewal, F., 2003a, pg. 95), 2,500 to 3,000 gallons (DeRewal, F., 2003a, pg. 107), and 4,000 gallons (DeRewal, F., 2003a, pg. 131).

80. Taking the initial time period as 1.5 years receiving 7.5 tanker loads of waste per week and the average of the tank sizes cited as 3,525 gallons<sup>3</sup>, the volume of bulk waste received in the initial period was calculated as

$$\frac{7.5 \text{ loads}}{\text{week}} \times \frac{52 \text{ weeks}}{\text{year}} \times 1.5 \text{ years} \times \frac{3,525 \text{ gal}}{\text{load}} = 2,062,125 \text{ gal}$$

plus an additional volume of waste received in the following two years

$$\frac{30 \text{ loads}}{\text{week}} \times \frac{52 \text{ weeks}}{\text{year}} \times 2 \text{ years} \times \frac{3,525 \text{ gal}}{\text{load}} = 10,990,000 \text{ gal}$$

for a total bulk waste received during these two periods of 13,060,125 gallons<sup>4</sup>.

81. If Freddy DeRewal hauled one tanker load of bulk waste from the Handy & Harman Facility to the Site for disposal, the representative volume of waste from the Handy & Harman Facility would have been 3,525 gallons. When compared with the total volume of bulk waste disposed at the Site, the total waste disposed of at the Site that could be attributed to

3. For this calculation, I used a conservative estimate of 3,525 gallons per tanker truck load to account for the differences in size between the different types of trucks used by DeRewal Chemical Company.

4. As a conservative measure, I only considered the 3.5 year time interval as described in the deposition testimony of Freddy DeRewal (DeRewal, F., 2003a, pg. 34) rather than extrapolating out to the full period of interest.

Handy & Harman would be

$$\frac{3,525 \text{ gal}}{13,060,125 \text{ gal}} = 0.00027 \text{ or } 0.027 \%,$$

a de minimis amount of waste, if any of the Handy and Harman Facility wastes ever reached the Site (USEPA, 1995d; USEPA, 1993b).

82. The amount of waste received in drums can be calculated from the number of drums recovered in the excavation activities reported in the Federal On-Scene Coordinator's Report (USEPA, 1993a) and the Remedial Construction Report OU-2 (Brown and Caldwell, 2004c). The total number of drums recovered by EPA was 2,500 (USEPA, 1993a) and the total number of drums removed with the remedial activities associated with OU-2 was 72 (Brown and Caldwell, 2004c).

83. Using a drum size of 55 gallons<sup>5</sup>, the total volume of drummed waste was

$$2,572 \text{ drums} \times 55 \text{ gallons} = 141,460 \text{ gallons.}$$

84. If, in the unlikely event that Bruce DeRewal's deposition testimony (B. DeRewal, 2003) is correct and 50 drums of waste from the Handy and Harman Facility reached the Site, this would have been equivalent to

$$50 \text{ drums} \times 55 \text{ gallons} = 2,750 \text{ gallons.}$$

The maximum allocation of drummed wastes attributable to the Handy & Harman Facility would have been

5. In order to be conservative, I used the value of 55 gallons for the volume of the individual drums removed from the Site. In some cases, this estimated volume exceeds the actual volume of waste disposed such as the case where the Handy & Harman Facility would have used some 30 gallon drums as well as 55 gallon drums. However, by using the value of 55 gallons per drum, the proportionate volume shares will remain the same and this calculation can account for at least a portion of the volume of wastes that was "emptied" and removed from drums at the time of disposal (See DeRewal, F., 2003a, pg. 86-87).

$$\frac{2,750gal}{141,160gal} = 0.019 \text{ or } 1.9 \%,$$

an insignificant quantity of wastes, if any of the Handy and Harman Facility wastes ever reached the Site.

85. Thus, the grand total volume of waste received as bulk plus the volume of the drummed wastes would be

$$13,060,125 \text{ gallons} + 141,460 \text{ gallons} = 13,201,585 \text{ gallons.}$$

Of this total,

$$\frac{141,460gal}{13,201,585gal} = 0.01072 \text{ or } 1.072\%$$

of the total waste disposed of at the Site, was received as drummed waste.

86. If the statements made in Bruce DeRewal's deposition (B. DeRewal, 2003) are taken at face value and 50 drums of waste from the Handy and Harman Facility reached the Site, the volume of drummed waste would be 2,750 gallons. Further, if Freddy DeRewal actually hauled one bulk load of spent acids to the Site from the Handy and Harman Facility (which is highly unlikely, see Paragraph 35 above), that would have added an additional 3,525 gallons of waste for a total of

$$2,750 \text{ gallons} + 3,525 \text{ gallons} = 6,275 \text{ gallons.}$$

Thus, based on the deposition testimony of Bruce and Freddy DeRewal, the fraction of the total waste disposed of at the Site that could be attributed to the Handy & Harman Facility would be

$$\frac{6,275gal}{13,201,585gal} = 0.00048 \text{ or } 0.048 \%,$$

a truly de minimis amount, if any of the wastes from the Handy and Harman Facility ever reached the Site (USEPA, 1995d; USEPA, 1993b).

X. Reservation of Right to Amend Report

87. I reserve the right to supplement or modify the opinions expressed herein upon which I expect to testify, to add to or modify the bases and reasons for my opinions and supplement the exhibits that I may use at trial for any of the following reasons: (1) to respond to expert reports, including but not limited to rebuttal reports, conducted for Plaintiffs or for any other party; (2) to respond to new information; (3) to respond to information obtained in discovery, including but not limited to depositions and interviews; and (4) as permitted by Rule 26 Fed. R. Civ. P. and the Scheduling Orders in this case.

**Table 1: Contents of Drums Removed at the Boardhead Farms Superfund Site from the Federal On-Scene Coordinator's Report**

Waste Group	# of Drums	Phase	Analysis	Arsenic	Copper	Cyanide	Cadmium	Chromium Lead	Mercury	Selenium	Silver	Zinc	Benzene	COH	DCA	DNT	MEK	Nitrobenzene	PCE	TCE
1	26	liquid	on cd cr pb			X	X	X		X										
2	25	liquid	cd cr hg				X	X	X											
3	21	liquid	cd cr pb ss				X	X												
4	22	liquid	cd cr pb				X	X												
5	13	liquid	cr ss cd cr ss	X			X	X												
6	20	liquid	on cd cr hg ss			X	X	X												
7	20	liquid	cr ss cd cr ss ss	X		X	X	X												
8	24	liquid	cd cr pb ss TCE			X	X	X												
9	15	liquid	cd cr pb ss MEK TCE			X	X	X												
10	19	liquid	cd cr PCE TCE				X	X											X	
11	21	liquid	MEK TCE														X			
12	22	liquid	TCE																	
13	21	liquid	cd hg MEK				X	X									X			
14	17	liquid	cd hg TCE				X	X												
15	25	liquid	cd cr Benzene				X	X					X							
16	25	liquid	cd cr				X	X												
17	29	liquid	cd cr				X	X												
18	26	liquid	cd cr ss				X	X												
19	27	liquid	CDPDCOA TCE				X	X												
20	33	liquid	cd cr				X	X												
21	20	liquid	cd cr DCA				X	X							X					
22	20	liquid	cd benzene, DNT				X	X								X				
23	20	liquid	cd cr benzene				X	X												
24	10	solid	cd TCE				X	X												
25	8	liquid	cd cr pb Benzene Nitrobenzene TCE				X	X												
26	15	liquid	cd cr Benzene TCE				X	X										X		
27	50	liquid	cd cr pb ss Benzene				X	X												
28	46	liquid	cd cr Benzene TCE				X	X												
29	16	liquid	cd cr				X	X												
30	22	liquid	cd cr benzene TCE				X	X												
31	101	liquid	cd cr Benzene TCE				X	X												
32	24	solid	cd cr TCE				X	X												
33	10	liquid	Benzene Nitrobenzene PCE TCE				X	X												
34	34	liquid	cd cr Benzene Nitrobenzene TCE				X	X												
35	26	liquid	Benzene COA MEK TCE				X	X												
36	7	liquid	cd cr pb MEK PCE TCE				X	X												
37	24	liquid	cd cr MEK PCE TCE				X	X												
38	24	liquid	cd cr MEK TCE				X	X												
39	16	liquid	cr TCE				X	X												
40	15	liquid	cr pb hg Benzene MEK TCE				X	X												
41	12	liquid	cd cr pb				X	X												
42	18	liquid	cd cr hg Benzene PCE TCE				X	X												
43	8	liquid	Benzene PCE TCE				X	X												
44	13	solid	cd pb Benzene TCE				X	X												
49	51	liquid	cd cr pb TCE, cu		X		X	X												
50	18	liquid	cd cr				X	X												
51	17	liquid	MEK				X	X												
52	26	liquid	cr pb MEK				X	X												
53	23	liquid	cd cr pb PCE TCE, cu		X		X	X												
54	30	liquid	cr pb				X	X												
55	48	liquid	cd cr pb MEK, cu		X		X	X												
56	4	liquid	cd cr pb				X	X												
57	8	liquid	cd cr pb				X	X												
58	13	liquid	pb MEK TCE				X	X												
59	4	liquid	cr MEK					X												
60	5	liquid	cd cr pb MEK, cu				X	X												
61	6	liquid	cr pb		X		X	X												
62	1	liquid	ss cr pb hg zn	X				X												
Total	1245	liquid - 1198 solids - 47		34	127	78	1043	1065	427	88	188	46	1	413	53	20	251	33	110	635

Sources: EPA, 1983. Federal On-Scene Coordinator's Report for Bouthard Farms NPL Site. June 18, 1982 to September 17, 1983.

Acronyms Used: CCl<sub>4</sub> = Carbon tetrachloride; DCA = 1,2-Dichloroethane; DNT = 2,4-Dinitroethane; MEK = Methyl Ethyl Ketone; PCE = Tetrachloroethylene or Perchloroethylene; TCE = Trichloroethylene; ss = selenide; cd = cadmium; cr = chromium; cu = copper; hg = mercury; pb = lead; se = selenium; sg = silver; zn = zinc



***Kirk W. Brown, Ph.D.***

**Biographical Data**

Principal Consultant; SI Group, LP

Born: July 3, 1940; Bethlehem, PA

Citizenship: U.S.A.

Social Security Number: 171-32-2297

Marital Status: Married No. of Children: 3

**Education**

Ph.D., Agronomy, University of Nebraska, 1969

M.S., Agronomy/Plant Physiology, Cornell University, 1964

B.S., Agronomy, Delaware Valley College, 1962

**Areas of Expertise**

Characteristics of Hazardous and Municipal Wastes; Industrial Waste Stream Identification; Classification and Fingerprinting of Waste Materials; Disposal of Municipal, Industrial, and Hazardous Waste by Land Treatment and Landfilling; Land Treatment of Sewage Sludge, Industrial Wastewater and Sludge; Fate and Movement of Salt, Oil, Metals, Organic Chemicals, Gases, Nutrients, Pesticides and Pathogens in Soil and Groundwater Environments; Remediation of Metal and Organic Chemical Contaminated Soils and Groundwater; Leachability and Translocation of Metals in the Soil Profile; Fixation and Stabilization of Metals in the Environment; Bioremediation of Polluted Soils; Vapor Extraction of Soils; Toxicity and Risk-based Assessment of Soil Contaminants to Plants and Animals; Flux of Volatile Chemicals from the Soil Surface; Influence of Chemicals on the Permeability of Landfill Liners; Sources and Transport of Methane; Composting of Municipal and Hazardous Waste; Design and Operation of Septic Systems; Nonpoint Source Pollution; Expansive Properties of Clay Soils; Soil Solution Sampling; Fate of Mutagenic Compounds in Soil; Mold and Fungal Growth; Reclamation of Drastically Disturbed Lands; Aerial Photo Interpretation; Soil Use and Suitability Classification; Agricultural Water Use Efficiency; Crop Water Stress; Golf Green and Athletic Field Construction; Use of Windbreaks; Soil Crusting; Gas Movement in Soil.

***Academic***

Professor Emeritus, Soil and Crop Sciences, Texas A&M University, 2001-Present.

Professor, Soil and Crop Sciences, Texas A&M University, 1981-2001.

Associate Professor, Soil and Crop Sciences, Texas A&M University, 1973-1981.

Assistant Professor, Soil and Crop Sciences, Texas A&M University, 1970-1973.

Visiting Scientist, Center of Plant Physiological Research, Wageningen, Netherlands, August, 1969-July, 1970.

Research Assistant, University of Nebraska, June, 1965-December, 1969.

Teaching Assistant, Cornell University, September, 1964-June, 1965.

**COURSES TAUGHT**

**Soil Physics (Undergraduate Course No. 445) 1970-2001.**

The practical aspects of soil texture, structure, water management, as well as the theoretical aspects of soil water potentials, and the movement of water, ions, gas, and heat in the soil.

**Advanced Soil Physics (Graduate Course No. 617) 1970-1988.**

An in-depth study of the physical properties of soil including basic principles which regulate the dynamics of soil, water and ion movement, soil aeration, and soil thermal relationships. Equations describing these processes are presented and references to current literature are provided for outside reading.

**Reclamation of Drastically Disturbed Lands (Graduate Course No. 615) 1979-1986.**

Kirk W. Brown

Concepts influencing the reclamation, revegetation, and establishment of a stable ecological system on lands that have been drastically disturbed by strip mining, severe erosion, or toxic waste contamination.

**Land Disposal of Wastes (Graduate Course No. 616) 1987-2001.**

The theoretical and practical aspects of the land treatment and landfilling of a wide range of municipal, industrial, and hazardous wastes. Emphasis has been placed on the fate and mobility of various waste constituents in the soil and the influence of soil physical and chemical properties on constituent fate.

***Short Courses Taught***

Soil Science Institute (One month course) 1984, 1986, 1992, 1993

Land Treatment of Industrial Waste - Chemical Engineering Society, 1982, 1983.

Landfill Liner Design, University of Texas - 1986, 1987.

**Society Memberships**

American Society of Agronomy, 1970-2001

Soil Science Society of America, 1970-2001

American Chemical Society, 1970-2001

International Society of Soil Science, 1970-2001

**Editorial Board**

Environmental Engineering Science, formerly Hazardous Waste and Hazardous Materials. 1989-2001.

**Reviewed Papers For**

Soil Science Society of America Proceeding; Soil Science, Journal of Environmental Quality; Environmental Engineering Science, formerly Hazardous Waste and Hazardous Materials; ATSDR; American Petroleum Institute; Water, Air & Soil Pollution; Waste Management & Research, Water Pollution Control Federation; Water Research; Waste Management; Journal of Hazardous Materials; Archives of Environmental Contamination and Toxicology.

**Elected Positions**

Chairman, ASA Section A5, 1989-90

General program chairman for ASA meetings, 1973

Chairman, ASA Section A3, 1972

**Committee Appointments**

National Academy of Sciences, National Research Council Committee on Environmental Technologies Subcommittee on Landfills (1995-1998).

EPA Review for Risk Assessment for Petroleum Industry Hazardous Waste Listing Determination (Sept 1995).

Environmental Geosciences Advisory Committee of the American Geological Institute representing the Soil Science Society of America (1993-2000).

National Academy of Sciences (NRC) Committee on Remedial Action Priorities for Hazardous Waste Sites (1991-1994).

Texas Natural Resource Conservation Commission Committee on rules on Wastewater Treatment Plant Sludge, Water Treatment Plant Sludge and Septic Tank Sludge Disposal (1992-1993).

Texas Water Commission Committee to Develop Regulations on the Land Application of Sewage Sludge (1992-93).

Faculty of Toxicology Executive Committee, Texas A&M University (1990-93).

Texas Governor's Infrastructure Committee on Free Trade (1991).

Oklahoma Corporation Commission on Land Application of Oil Field Drilling Waste (1990-1991).

Texas Department of Health Ad Hoc Committee for Revising the Construction Standards for On-Site Sewage Facilities (1989-90).

EPA Hazardous Waste Center Review Panel (1988).

National Science Foundation, Environmental Engineering Div., Review Panel (1987-1995).

Texas Dept. of Health Septic Disposal Regulations Revision Panel (1987).

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Advisory Panel to Chicot Aquifer Management Project (Louisiana). McNeese State University, LA (1987-1990).  
 ASA Editorial Committee "Reaction and Movement of Organic Chemicals in Soils" 1987.  
 Advisory Panel to U.S. Congressional Office of Technology Assessment (OTA) on An Assessment of the Effectiveness of the EPA in Identifying, Prioritizing and Cleaning Up Hazardous Waste Sites (1987-1995).  
 Organizing Committee for SSSA Workshop on Utilization, Treatment and Disposal of Waste on Land (1985).  
 Panel to Write Research Needs for Hazardous Wastes Treatment and Disposal for National Science Foundation. Drexel University, PA (1986).  
 EPA Technical Advisory Panel on the Adequacy of Ground Water Monitoring at Hazardous Waste Landfills (1985).  
 Panel to Write the Mutagenicity Sample Preparation Protocol for EPA (1984).  
 EPA Panel to Review the Acceptability of Landfill Disposal of Sewage Sludge (1984).  
 Office of Water Regulations and Standards Committee on Municipal Sludge Landfilling to Advise EPA on the Pollutants which should be Regulated for Various Disposal Options and the Methods or Procedures to be Used for Regulating such Pollutants (1984).  
 Advisory Panel to U.S. Congressional Office of Technology Assessment (OTA) to Determine the Effectiveness of Current Programs to Clean Up Uncontrolled Hazardous Waste Sites (1983-84).  
 EPA Science Review Panel for Environmental Engineering Research Grants (1982-1998).  
 United States Environmental Protection Agency Land Treatment Task Force (1981-1985).

#### **Significant Reports Resulting from Committee Assignments**

National Research Council. 1999. "Groundwater & Soil Cleanup, Improving Management of Persistent Contaminants".  
 National Research Council. 1994. "Ranking Hazardous Waste Sites".  
 Office of Technology Assessment, Congress of the United States of America. 1989. "Coming Clean, Superfund Problems Can be Solved".  
 Office of Technology Assessment, Congress of the United States of America. 1985. "Superfund Strategy".

#### **University Committees**

Texas A&M University Environmental Safety and Health Committee (1987-90).  
 Council of Principal Investigators, Texas A&M University (1986-1990).  
 Texas Agricultural Experiment Station 5-Year Planning Board.  
 Texas A&M University Faculty Forum (1979-82).  
 Texas Agricultural Experiment Station Grant Support Committee (1976-77).

#### **Awards**

Texas A&M University College of Agriculture Award for Excellence in Teaching (1995)  
 Texas A&M University System Award for Excellence in Graduate Teaching (1988)  
 ASA Environmental Quality Research Award (1988)  
 Fellow - Soil Science Society of America (1987)  
 Fellow - American Society of Agronomy (1986)  
 Distinguished Alumni Award, Delaware Valley College (1986)  
 Superior Achievement Award for Research, Soil and Crop Sciences Department, Texas A&M University (1986)  
 Pollution Engineering Magazine Award of Merit for Outstanding Editorial Contribution "The Case for Aboveground Landfills" (1984)

#### **Books Authored**

*Hazardous Waste Land Treatment*. 1983. Butterworth Publishers, 10 Tower Office Park, Woburn, MA 01801.  
*Reactions and Movement of Organic Chemicals in Soils*. 1989. Sawhney, B. L. and K. W. Brown. SSSA/ASA Publishers, SSSA Special Publication No. 22, 494 pgs.

#### **Professional Experience Outside the United States**

Visiting Scientist at Center of Plant Physiological Research, Wageningen (1969-70).

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#### **Testimony Before Legislative Bodies**

Texas House of Representatives - Environmental Affairs Committee, April 1987. Testified on the need for legislation to set up a waste management plan for the state.

Texas Governor's Taskforce on Oil Spills, February 1985. Testified on the fate of oil spill debris and disposal technology options.

Texas Governor's Taskforce on Hazardous Waste, November 1984. Testified on the effectiveness of landfills for disposal technology.

Texas Governor's Taskforce on Hazardous Waste, June 1984. Testified on the impact of organic chemicals on the permeability of soils.

U.S. House of Representatives - Science and Technology Committee, November 1982. Testified on the adequacy of EPA's liquid management system to protect groundwater at hazardous waste landfills.

Texas House of Representatives - Environmental Affairs Committee, April, 1982. Testified on the impact of organic chemicals on the permeability of clay liners.

#### **Consulting**

Founder and President of K. W. Brown and Assoc., Inc., (1980- 1991). Chief technical consultant to K. W. Brown Environmental Services (1991-1999) and SI Group, LP (2000-Present). Past consulting activities have included assignments with a variety of industries, state, and federal government agencies, including General Motors Corporation, Minnesota Mining & Manufacturing, WR Grace, Union Pacific Railroad, Chevron, Shell, Exxon, Texaco, Arco, Sunoco, El Paso Products, New York Attorney General's Office, Illinois Attorney General's Office, Minnesota Attorney General's Office, Michigan Pollution Control Administration, U.S. EPA, U.S. Army Corps of Engineers, and U.S. Dept. of Justice.

As a consultant, I conducted an extensive survey of industrial and manufacturing facilities, with an emphasis on industrial processes, waste streams generated, and the disposal practices of these facilities. As a result of this expertise I have been able to evaluate or analyze hazardous substances in industrial waste streams from numerous industries including the lumber and paper industries, the printing industry, chemical manufacturing, petroleum processing and refining, plastics and rubber products industry, leather tanning and finishing, metal smelting and finishing, electric utilities, and the electronic components manufacturing industry, among others. I have conducted extensive research on the hazardous substances contained in municipal and household waste with a special emphasis on the fate and mobility of these constituents in the environment after disposal in municipal solid waste landfills.

Consulting activities have included consultations on the cleanup and disposal of wastes, the impacts of hazardous waste on the environment, the design of hazardous waste landfills and solid waste management units, and the fate and mobility of chemicals in the soil, groundwater, and air, as well as, providing expert testimony at permit hearings, mediation hearings, civil suits, and before legislative bodies on these topics. My expertise has been utilized for site assessments, data review and interpretation, the study of fate and transport of contaminants in the environment, waste management activities, historical landfill operations, and other related environmental matters. I have reviewed and interpreted a large quantity of analytical data for air, soils and groundwater, as well as borings logs, field logs, technical reports, and other information related to the environmental conditions of a site. Under the auspices of both state and federal regulatory authorities I have prepared and reviewed remedial action plans for hundreds of sites including contaminated with metals, organic chemicals, pesticides, biological pathogens and petroleum production wastes. Sites for which I have provided evaluations and assessments include: Love Canal Landfill, Lowrey Landfill, Helen Kramer Landfill, Junker Landfill, Lemberger Landfill, Laurel Park Landfill, Beacon Heights Landfill, RCA-Buzby Landfill, Valleycrest Landfill, Lone Pine Landfill, Ft. Bend County Landfill, and Sinton Landfill, among others. In addition, I have also provided expert testimony for civil actions involving the following Superfund sites: Hardage Criner, Montana Pole, National Gypsum, Brio/Dixie Oil Processors, Sikes' Pits, Turtle Bayou, Metal Bank of America, Tar Creek, and the West Dallas Lead Site.

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#### Guest Lectures

- Dewatering of confined dredge spoil areas. In: *Second International Symposium on Dredging Technology*. BHRA Fluid Engineering, Cranfield, Bedford, England. Paper G1:1-24. (1977).
- Revegetation of drastically disturbed lands. Texas A&M Lignite Symposium. April 17-18. (1980).
- Impact of surface mining on water quality. Texas A&M Lignite Symposium, April 17-18, 1980.
- Factors influencing the biodegradation of API separator sludges applied to soils. Presented at the Seventh Annual Research Symposium at Philadelphia, PA. March 16-18, 1981.
- Land treatment of industrial hazardous wastes. Presented at a Symposium and Workshop on Hazardous Waste Management. Louisiana State University, November 16-20, 1981.
- Effect of organic chemicals on clay liner permeability. A review of the literature. Presented at the Sixth Annual Research Symposium at Philadelphia, PA. 1981.
- Land disposal of oily wastes. Brest, France. August, 1982.
- Influence of organic liquids on the permeability of clay soils. Harwell, Great Britain. July, 1982.
- Use of sewage effluent for irrigation. Adelaide, Australia. June, 1982.
- Influence of organic liquids on the integrity of liners to pits, ponds, lagoons and landfills. Waste Water Analysts Assoc., Houston, TX. November, 1982.
- Reclamation of strip mined lands. Sierra Club, Austin, TX. November, 1982.
- Waste disposal on range land. Range Science Department, Texas A&M University. College Station, TX. November, 1982.
- The politics of hazardous waste disposal. Political Science Department, Texas A&M University. College Station, TX. October, 1982.
- The treatment and disposal of hazardous, industrial and toxic waste. American Society of Civil Engineers, Austin, TX. September, 1982.
- Effect of organic fluids on the permeability of clay soil liners. Presented at the Eighth Annual Research Symposium at Ft. Mitchell, Ky. March 8-10, 1982.
- The fate of mutagenic compounds when hazardous wastes are land treated. Presented at the Eighth Annual Research Symposium at Ft. Mitchell, Ky. March 8-10, 1982.
- The influence of chemicals on the permeability of clay liners. Presented at Hazardous Waste Conference, Chicago, Ill. June 28-29, 1983.
- Cleanup of chemicals spilled on soils. Presented at the Texas Agricultural Extension Service Conference, Houston, Texas. June 23, 1983.
- The reclamation of strip mined land. Presented at Texas Environmental Coalition in Austin, Texas Jan. 22, 1983.
- The influence of selected organic liquids on the permeability of clay liners. In: D. W. Shultz (ed). *Land Disposal, Incineration, and Treatment of Hazardous Waste*. Proceedings of the 9th Annual Research Symposium at Ft. Mitchell, Ky. May 2-4, 1983.
- Panel on land treatment of sewage sludge. EPA Workshop on Sewage Disposal, Denver, CO. March 1983.
- Land disposal of hazardous liquids. Waste Management Conference, Houston, TX. February 1983.
- Alternatives to land disposal of waste. Dept. of Agriculture Seminar, University of Houston. Sept. 10, 1984.
- How to write a successful research proposal. Soil Science Graduate Seminar, Soil & Crop Sciences Dept, Texas A&M University, Sept. 19, 1984.
- The advantages of above ground disposal. Waste Tech Conference, Houston, October 30, 1984.
- Potential groundwater implications of surface storage of toxic substances. Groundwater Symposium, Gunter Hotel, San Antonio, Texas. October 30, 1984.
- Clean up of spills; Alternative disposal methods. Geotechnical Engineering for Waste Disposal Symposium, University of Texas, Austin. November 2, 1984.
- The properties of soils and containment of waste. Environmental Engineering Seminar, Civil Engineering Dept., Texas A&M University, College Station, 1984.
- Carbon dioxide flux at the earth's surface. Texas A&M University, College Station, February 1984.
- Above ground landfills in hazardous waste management schemes. National Conference and Exhibition on Hazardous Waste and Environmental Emergencies. Houston, Texas, March 1984.
- Fate of mutagens applied to soil. Environmental Toxicology and Pharmacology Seminar. Texas A&M University, College Station, March, 1984.

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Permeability of compacted soils to solvents mixtures and petroleum products. Presented at the Tenth Annual Research Symposium at Cincinnati, Ohio, April 1984.

Simulation of Potential Rainfall Conservation from Two Cross-Diked Furrow Bed Designs. Texas A&M University, College Station. February 1984.

The soil scientist as a consultant. Soil Science Graduate Seminar, Panel Discussion. Soil & Crop Sciences Dept, Texas A&M University, Sept. 12, 1984.

Land disposal of hazardous waste. Agricultural Engineering Dept. Graduate Seminar, Agricultural Engineering Dept., Texas A&M University. Sept. 13, 1984.

Geotechnical engineering for waste disposal projects. University of Austin, Texas, October 1985.

Monitoring the unsaturated zone. Presented at the National Specialty Conference. Land Treatment: A Hazardous Waste Management Alternative, April 16-18, 1985, Austin, Texas.

Ability of sorbents to retain liquids in landfills, 10th Annual American Organization of Analytical Chemists' Spring Workshop, Dallas, Texas April, 9-11, 1985.

Geotechnical engineering for waste disposal projects. University of Austin, Texas, October 1986.

Potential health effects of hazardous waste contaminants in groundwater. Public Health Grand Rounds, University of Pittsburgh Graduate School of Public Health. January 23, 1986.

Geotechnical engineering for waste disposal projects. University of Texas, Austin, October 1986.

Influence of organic liquids on the hydraulic conductivity of soils. University of Cambridge, United Kingdom. September 9-11, 1987.

Design and construction of the growth media in golf greens, Montreal, Canada, 1987.

Groundwater pollution problems associated with fertilizers, pesticides, and leaking storage tanks. Pro Show, Dallas, November 1987.

Mutagenic testing of hazardous waste sites. Southwest Environmental Mutagenic Society, Houston, November 1987.

The use of lime for waste disposal and treatment of hazardous waste contaminated sites. National Lime Association, Phoenix, AZ, April 1987.

A soil scientist as an expert witness - Presented to the Soil Survey and Land Resource Workshop. February 19, 1988.

Guest lecture to Rio Brazos Audubon Society - May 2, 1988.

Presentation to the Texas Association of Milk, Food and Environmental Sanitarians, June, 1988.

Guest lecture to Range Science Ecology and Land Use class. Dept. of Range Science, Texas A&M University, Nov. 18, 1988.

Hazardous Waste: A general overview. Agricultural Engineering, Environmental and Water Resources Engineering and Texas Water Resources Institute Seminar, Texas A&M University, College Station, TX. January 1989.

The need for community recycling. Environmental Organization, Civil Engineering Dept., Texas A&M University, College Station, TX. February 1989.

Superfund sites: The problems and the solutions. Industrial Hygiene Seminar, Texas A&M University, College Station, TX. February 1989.

Hazardous waste disposal on the Gulf Coast Texas. Texas ASA Annual Meeting. Galveston, Galveston County, Texas, February 1989.

New technologies for liners - Presented at the Conference on Prevention and Treatment of Groundwater and Soil Contamination in Petroleum Exploration and Production. Calgary, Alberta, Canada, May 9-12, 1989.

Guest Lecture to Range Science Ecology and Land Use Class: Dept. of Range Science, Texas A&M University, College Station, TX. Oct. 4, 1989.

Ongoing and future research in the geowaste area. Presented to the Geo Waste Group Meeting, Civil Engineering Dept. Texas A&M University, Nov. 1, 1989.

Waste disposal: where do we go from here? Presented to the MSC Great Issues: Environmental Symposia. Texas A&M University, College Station. Nov. 7, 1989.

Innovative technologies from the 1990s in environmental matters. Presentation to South Texas College of Law Environmental Law Symposium, January 17, 1990.

Waste disposal, past, present, and future. Presented at the seminar entitled "Disposing of Hazardous Materials". MSC, Texas A&M University, College Station, TX January 1990.

Panel discussion session at Vertisol Management Workshop: International Collaboration in Research, Training and Extension. Texas A&M University, College Station, June 25-29, 1990.

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- Municipal waste disposal - where do we go from here. Presentation to Texas Environmental Action Coalition, Texas A&M University, College Station, TX. Sept. 5, 1990.
- Presentation to the Texas Section of American Society of Agricultural Engineers, College Station, TX. October 11, 1990.
- Presentation on golf green construction at Canadian Golf Superintendents Association Conference, Montreal, Canada. Dec. 11, 1990.
- Environmental Soil Science and Technology. Presentation to the 1991 Texas Agric. Experiment Station Conference - Environmental Soil Science Session, College Station, TX. January 1991.
- Movement of pesticides to groundwater. Presentation to the Texas Association of Agricultural Consultants. Austin, Texas, January 21, 1991.
- Movement of pesticides to groundwater. Presentation to the Texas Agricultural Extension Service Conference for Producers, Austin, TX, January 25, 1991.
- Pesticide rinsate disposal options. Presentation to the Research Center Administrators Society meeting, Dallas, Texas February 3-5, 1991.
- Movement of pesticides to groundwater. Presentation to the Texas Agricultural Extension Service Conference for Grounds Keepers. Round Rock, Texas, February 21, 1991.
- Liners for Hazardous Waste Sites. Presented at the Hazardous Waste Management Division's Lecture Series. U.S. Environmental Protection Agency, Region 6, 1445 Ross Ave., Suite 1200, Dallas, TX. 1991.
- Decontamination of polluted soils. Presented at the Second International Conference on the Biogeochemistry of Trace Elements, Taipei, Taiwan, Republic of China. Sept. 5-10, 1993.
- Using plants to reclaim contaminated sites. Crop Science Seminar. Soil & Crop Sciences Dept., Texas A&M University, College Station, TX, October 24, 1994.
- Vadose zone modeling of the fate and movement of volatile contaminants, Geological Society of America, South-central Section Conference, Austin, TX, March 12, 1996.
- Banning of liquid wastes from landfills - development of the technical data and the regulations, South Texas Environmental Conference, Corpus Christi, TX, March 29, 1996.
- The science behind RCRA/CERCLA enforcement (Part II), Science For Environmental Attorneys, Denver CO, November 6, 1997.

#### Scientific Publications

1. Allen, L. H. and K. W. Brown. 1965. Shortwave radiation in a corn crop. *Agron. J.* 57:575-580.
2. Brown, K. W. and W. Covey. 1966. The energy budget evaluation of the micrometeorological transfer processes within a corn field. *Agri. Meteorol.* 3:73-96.
3. Brown, K. W. and L. J. Wright. 1967. Comparison of momentum and energy balance method of computing vertical transfer within a crop. *Agron. J.* 59:427-432. C701.
4. Brown, K. W. and N. J. Rosenberg. 1968. Errors in sampling and infrared analysis of CO<sub>2</sub> in air and their influence in determination of net photosynthetic rate. *Agron. J.* 60:309-311.
5. Brown, K. W. 1969. A model of the photosynthesizing leaf. *Phys. Plant* 22:620-637.
6. Brown, K. W. and N. J. Rosenberg. 1969. Computer program for plotting time dependent meteorological data. *Agric. Meteorol.* 6:463-464.
7. Brown, K. W. and N. J. Rosenberg. 1970. Concentration of CO<sub>2</sub> in the air above a sugar beet field. *Mo. Weather Rev.* 98:75- 82.
8. Brown, K. W. and N. J. Rosenberg. 1970. The influence of leaf age, illumination and upper and lower surface differences on stomatal resistance of sugar beet (*Beta vulgaris*) leaves. *Agron. J.* 62:20-24.
9. Brown, K. W. and N. J. Rosenberg. 1970. The effect of windbreaks and soil water potential on stomatal diffusion resistance and photosynthetic rate of sugar beets (*Beta vulgaris*). *Agron. J.* 62: 4-8.
10. Brown, K. W. and N. J. Rosenberg. 1970. Energy and CO<sub>2</sub> balance of an irrigated sugar beet (*Beta vulgaris*) field in the Great Plains. *Agron. J.* 63:207-213.
11. Brown, K. W. and N. J. Rosenberg. 1970. Shading inverted pyranometers and measurements of radiation reflected from an alfalfa crop. *Water Res. Res.* 6:1782-1786.
12. Rosenberg, N. J. and K. W. Brown. 1970. Improvements in the van Bavel-Myer automatic weighing lysimeter. *Water Res. Res.* 6:1227-1229.
13. Briggs, W. W., A. R. Edison, J. D. Eastin, K. W. Brown, J. W. Marenville, and M. D. Clegg. 1971. Photosynthesis light sensor and meter. *Ecology* 52:125-131.

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14. Brown, K. W. and N. J. Rosenberg. 1971. Turbulent transport and energy balance as affected by a windbreak in an irrigated sugar beet (Beta vulgaris) field. *Agron. J.* 53:351-355.
15. Brown, K. W. and N. J. Rosenberg. 1971-2. Shelter-effects on micro-climate, growth and water use by irrigated sugar beets in the Great Plains. *Agric. Meteorol.* 9:241-263.
16. Brown, K. W. and N. J. Rosenberg. 1973. A resistance model to predict evapotranspiration and its application to a sugar beet field. *Agron. J.* 65:341-347.
17. Duble, R. L. and K. W. Brown. 1973. Environmental concerns for the golf superintendent. *USGA Green Section Record*. 11:10-13.
18. Brown, K. W. 1974. Calculations of evapotranspiration from crop surface temperature. *Agric. Meteorol.* 14:199-209.
19. Holder, C. B. and K. W. Brown. 1974. Evaluation of simulated seedling emergence through rainfall induced soil crusts. *Soil Sci. Soc. Amer. Proc.* 38:705-710.
20. Brown, K. W., C. J. Gerard, B. W. Hipp and J. T. Ritchie. 1974. A procedure for placing large undisturbed monoliths in lysimeters. *Soil Sci. Soc. Amer. Proc.* 38:981-983.
21. Rosenberg, N.J. and K. W. Brown. 1974. "Self-checking" psychrometer system for gradient and profile determinations near the ground. *Agric. Meteorol.* 13: 215-226.
22. Spotts, J. W. and K. W. Brown. 1975. A technique for installing induction coils in a profile with minimum soil disturbance. *Soil Sci. Soc. Amer. Proc.* 39: 1006-1007.
23. Jordan, W. R., K. W. Brown and J. C. Thomas. 1975. Leaf age as a determinant in stomatal control of water loss from cotton during water stress. *Plant Physiol.* 56:595-599.
24. Brown, K. W. and R. L. Duble. 1975. Physical characteristics of soil mixtures used for golf green construction. *Agron. J.* 67:647-652.
25. Brown, K. W. 1975. A device for isolating soil columns with minimum disturbance. *Soil Sci. Soc. Amer. Proc.* 39:1008-1009.
26. Brown, K. W. and N. J. Rosenberg. 1975. Annual windbreaks boosts yields. *Crop and Soils Magazine*. p. 8-11. Apr-May, 1975.
27. Brown, K. W. 1976. Chapter II. 3. Sugar beet and potatoes. In: Vegetation and the Atmosphere. (J. L. Monteith, ed.). Academic Press, NY. p. 65-86.
28. Thomas, J. C., K. W. Brown and W. R. Jordan. 1976. Stomatal response to leaf water potential as affected by preconditioning water stress in the field. *Agron. J.* 68:706-708.
29. Deuel, L. E., Jr., K. W. Brown, F. C. Turner, D. G. Westfall and J. D. Price. 1976. Persistence of Propanil, DCA, and TCAB in soil and water under flooded rice culture. *JEQ* 6:127.
30. Brown, K. W., W. R. Jordan and J. C. Thomas. 1976. Water stress induced alteration in the stomatal response to leaf water potential. *Phys. Plant.* 37:1-5.
31. Chaudhari, K. G., K. W. Brown, and C. B. Holder. 1976. Reduction of crust impedance to emergence by the addition of manure. *Soil Sci.* 122:216-222.
32. Deuel, L. E., Jr., F. C. Turner, K. W. Brown and J. D. Price. 1977. Persistence and factors affecting dissipation of molinate under flooded rice culture. *JEQ* 7:373-377.
33. Brown, K. W. 1977. Chapter 19. Shrinking and swelling of clay, clay strength and other bulk properties of clay soils and clays. In Minerals in Soil Environments. (J. B. Dixon and S. B. Weed eds.). Soil Sci. Soc. of Amer., pp. 680-707, Madison, WI.
34. Brown, K. W., R. L. Duble and J. C. Thomas. 1977. Nitrogen losses from golf green, *USGA Green Section Record*. 15:5-7.
35. Brown, K. W., F. C. Turner, J. C. Thomas and M. E. Keener. 1977. Water balance of flooded rice paddies. *J. of Agr. Water Use* 1:277-291.
36. Deuel, L. E. Jr., K. W. Brown, J. D. Price and F. C. Turner. 1977. Persistence of carbofuran and its metabolites, 3-keto and 3-hydroxy carbofuran, under flooded rice culture, *JEQ* 8:23-26.
37. Brown, K. W., R. L. Duble and J. C. Thomas. 1977. Influence of management and season on fate of N applied to golf greens. *Agron. J.* 69:667-671.
38. Brown, K. W. and L. J. Thompson. 1977. Dewatering of Confined Dredge Spoil Areas. Second International Symposium on Dredging Technology. 2-4, November, 1977, Texas A&M University pp. G1-1-G1-24.
39. Shive, J. B. and K. W. Brown. 1978. Quaking and gas exchange in cottonwood (Populus deltoides, Marsh) leaves. *Plant Physiol.* 61: 331-333.

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40. Duble, R. L., J. C. Thomas and K. W. Brown. 1978. Arsenic pollution from underdrainage and runoff from golf greens. *Agron. J.* 70:71-74.
41. Duble, R. L., K. W. Brown and J. C. Thomas. 1978. Increase fertilizer efficiency and reduce nutrient loss. *Golf Superintendent* 46:28-31.
42. Jones, S. G., K. W. Brown, L. E. Deuel and K. C. Donnelly. 1978. Influence of rainfall on the retention of sludge heavy metals by the leaves of forage crops. *JEQ* 8:69-72.
43. Brown, K. W. and J. C. Thomas. 1978. Uptake of nitrogen by grass from septic fields in three soils. *Agron. J.* 70:1037-1040.
44. Brown, K. W., D. C. Anderson, S. G. Jones, L. E. Deuel, Jr., and J. D. Price. 1979. The relative toxicity of four pesticides in tap water and water from flooded rice paddies. *Int. J. Env. Studies.* 141:49-54.
45. Brown, K. W., H. W. Wolf, K. C. Donnelly and J. F. Slowey. 1979. The movement of fecal coliform and coliphage below septic lines. *JEQ* 8:121-125.
46. Wagner, T. L., J. A. Gagne, P. C. Doraiswamy, R. N. Coulson and K. W. Brown. 1979. Development time and mortality of *Dendroctonus frontalis* in relation to changes in tree moisture and xylem water potential. *Environ. Entomol.* 8: 1129-1138.
47. Brown, K. W. and D. C. Anderson. 1980. Effect of organic chemicals on clay liner permeability: A Review of the Literature. In: D.W. Shultz (ed.). *Disposal of Hazardous Waste. Proceedings of the 6th Annual Research Symposium at Chicago, Illinois.* EPA-600/9-80-010. pp. 123-134.
48. Brown, K. W. and L. E. Deuel. 1980. Revegetation of Drastically Disturbed Lands. *Texas A&M Lignite Symposium*, April 17-18, 1980. pp. 19.0-19.8
49. Brown, K. W., L. E. Deuel, Jr. and J. C. Thomas. 1980. Optimization of land cultivation parameters. In: D.W. Shultz (ed.). *Disposal of Hazardous Waste. Proceedings of the 6th Annual Research Symposium at Chicago, Illinois.* EPA- 600/9-80-010. pp. 254-259.
50. Brown, K. W. and C. B. Holder. 1980. The relationship between oxygen and water uptake by roots of intact bean plants. *Soil Sci. Soc. Amer. J.* 44:21-25.
51. Brown, K. W., S. G. Jones, and K. C. Donnelly. 1980. The influence of simulated rainfall on residual bacteria and virus on grass treated with sewage sludge. *JEQ* 9(2):261-265.
52. Brown, K. W. and J. C. Thomas. 1980. The influence of the sand layer on available water retention in a golf green. *USGA Green Section Record* 18(6):5-7.
53. Brown, K. W. and J. C. Thomas. 1980. The influence of water stress preconditioning on dark respiration. *Physiologia Plantarum.* 49:205-209.
54. Brown, K. W., J. C. Thomas and A. Almodares. 1980. The necessity of the two-inch sand layer in greens construction. *USGA Green Section Record* 18(6):1-4.
55. Brown, K. W., L. J. Thompson, K. W. Launius and L. E. Deuel, Jr. 1980. Physical properties of dredged materials. *Soil Sci.* 129(2):95-106.
56. Turner, F. T., K. W. Brown, and L. E. Deuel. 1980. Nutrients and associated ion concentrations in Irrigation Return Flow from Flooded Rice Fields. *JEQ* 9(2):256-260.
57. Deuel, L. E. and K. W. Brown. 1980. Impact of surface mining on water quality. *Texas A&M Lignite Symposium*, April 17-18, 1980. pp. 16.1-16.5.
58. Anderson, D. C., and K. W. Brown. 1981. Organic leachate effects on the permeability of clay liners. In: *Proceedings of the 7th Annual Research Symposium at Philadelphia, PA.* EPA-600/9-81-002b, pp. 119-130.
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- "Fate of metals applied in sewage to land wastewater disposal sites." 1973-1974. Funded by the U. S. Army Medical Corps for \$137,780. Final Report submitted June, 1975.
- "Nutrient and pesticide retention in golf greens built to USGA Green Section specifications." 1972-1975. Funded by the U. S. Golf Association, Green Section for \$21,000. Final Report submitted October, 1975.
- "An investigation of the feasibility of soil disposal of wastewater from Jefferson Chemical Co." 1975. Funded by the Jefferson Chemical Co. for \$16,600. Final Report submitted October, 1975.
- "The influence of Petro S on the infiltration rate and water holding capacity of soil." 1974-1975. Funded by the Petro-chemical Co., Inc. for \$8,280. Final Report submitted December, 1975.
- "The influence of trickle irrigation on the quality of irrigation return flow." 1973-1974. Funded by Office of Water Resources Research for \$45,000. Final Report submitted March, 1976.
- "Analysis of overburden cores TPPI fuel deposit." 1976. Funded by the Texas Power Pool, Inc. for \$24,500. Final Report submitted February, 1977.
- "Feasibility study of general crust management as a technique for increasing capacities of dredged material containment areas." 1975-1976. Funded by the U. S. Army Engineers Waterways Exp. Station, Corps of Engineers for \$53,529. Final Report published April, 1977.
- "Analysis of four overburden cores." 1977. Funded by the Paul Weir Co. for \$5,600. Final Report submitted July, 1977.
- "Accumulation and passage of pollutants in domestic septic tank disposal fields." 1973-1975. Funded by the U. S. Environmental Protection Agency for \$294,864. Final Report submitted December, 1977.
- "Development of management guidelines to prevent pollution by irrigation return flow from rice fields." 1972-1975. Funded by U. S. Environmental Protection Agency for \$197,850. Final Report published April, 1978.
- "Physiological model of plant growth and development of ecosystem simulation." 1975-1978. Funded by the National Science Foundation for \$129,813. Final Report submitted June, 1978.
- "Evaluate the feasibility of revegetating mixed overburden at the proposed Angelina County lignite site." 1977-1978. Funded by the Sunoco Energy Development Company for \$46,031. Final Report submitted June, 1979.
- "Characteristics of overburden material and revegetation analysis for the Southwest Electric Power Company Deposit." 1977- 1978. Funded by the Southwest Electric Power Company for \$53,600. Final Report submitted July, 1979.
- "The impact of surface lignite mining on surface and groundwater quality." 1978-1979. Funded by the Texas Energy Advisory Council for \$61,022. Final Report submitted September, 1979.
- "Analysis of groundwater quality and the probable quality of leachate, TMPA Fuel Deposit, Grimes County, Texas." 1977. Funded by the Municipal Power Agency for \$20,205. Final Report submitted November, 1979.
- "To investigate the feasibility of irrigation disposal of uranium stripping reclamation water." 1979. Funded by nine private companies for \$9,869. Final Report submitted December, 1979.
- "Statistical and biophysical modeling of Dendroctonus frontalis-Host tree dynamics: II. Physical models of Dendroctonus frontalis - Host tree systems." 1975-1979. Funded by the USFS-CSRS Expanded Southern Pine Beetle Program for \$174,780. Final Report submitted December, 1979."
- "Investigate the concentration of heavy metals and other parameters in lignite overburden cores from Grimes County." 1978. Funded by Texas Municipal Power Agency for \$7,192. Final Report submitted.
- "To investigate the feasibility of irrigation disposal of uranium stripping leach water. Phase II: Laboratory Study." 1979. Funded by Mobil Oil Corp. for \$20,000. Final Report submitted January, 1980.
- "To investigate the necessity of a sand layer between the top mixture and gravel layer in golf green construction." 1978-1979. Funded by the United States Golf Association, Greens Section for \$3,220. Final Report submitted March, 1980.

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- "To develop a plan to minimize the volume of runoff water which must be treated and disposed of and to assess the feasibility of land disposal of the runoff water and sludge." 1979-1980. Funded by Texas Engineering Extension Service for \$11,058.40. Final Report submitted April, 1980.
- "Investigate the concentration of heavy metals and certain other physical and chemical properties - Gibbons Creek Lignite Mine." 1980. Funded by Texas Municipal Power Agency for \$12,500. Final Report submitted April, 1980.
- "Improved water and nutrient management through high-frequency irrigation." 1977-1980. Funded by Texas Water Resources Institute for \$179,435. Work completed June, 1980.
- "Environmental and safety aspects of the use of sulfur in highway pavements." 1980. Funded by the DOT-Federal Highway Administration for \$38,951. Final Report submitted August, 1980.
- "Root distribution of bermudagrass grown on reclaimed lignite spoil." 1980-1981. Funded by the Center for Energy and Mineral Research for \$12,590. Final Report submitted August, 1981.
- "A residual evaluation of the influence of chemicals on the permeability of soil clays." 1979-1980. Funded by the Environmental Protection Agency for \$91,783. Report submitted December, 1981.
- "Investigate the influence of organic matter quality and placement on the establishment of grass and the physical properties of golf green mixes." 1979-1981. Funded by the U. S. Golf Association, Green Section for \$10,177. Final Report submitted February, 1982.
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- "Soil disposal of API pit wastes." 1977-1980. Funded by the Environmental Protection Agency for \$184,104. Final report submitted in 1981.
- "Evaluate subsurface landfarm contamination after long term use." 1980-1981. Funded by the American Petroleum Institute for \$98,530. Final Report published in 1983.
- "The use of bioassays to evaluate the environmental impact of land treatment of hazardous industrial wastes." 1980-1983. Funded by the Environmental Protection Agency for \$383,732. Final Report published in 1985.
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- "Quantify leak rates through holes in landfill liners" 1983-1985. Funded by Environmental Protection Agency for \$232,769. Final report submitted in 1986.
- "Efficiency of soil core and soil-pore liquid sampling systems". 1983-1985. Funded by Environmental Protection Agency for \$101,766. Final report submitted in 1986.
- "Completion of Field Investigation and an Evaluation of Mechanisms by which Organic Liquids Alter the Permeability of Clay Soils". 1984-1985. Funded by EPA for \$59,000. Final report submitted in 1986.
- "Mobility and Stability of Mutagenic Compounds in Municipal Sewage Sludge Amended Soil." 1984-1986. Funded by Environmental Protection Agency. for \$281,800.
- "Development of a Capillary Wick Unsaturated Zone Pore Water Sampler." 1985-1986. Funded by Environmental Protection Agency for \$236,353.
- "Evaluation of the Thickness of Clay Liners Required to Meet RCRA Requirements". Funded by Environmental Protection Agency. 1987-1989. First year funding \$122,184.
- "Development of a Pesticide Rinse Water Digester". 1986-88. Funded by Texas Water Resource Institute for \$58,000.
- "Determination of the optimum furrow dike size to minimize rainfall runoff". 1985. Funded by Texas Water Resource Institute for \$17,500.
- "In situ vapor extraction of volatile contaminants at Superfund sites" 1987-88. Funded by Texas Water Resource Institute for \$40,000.
- "Development of a comprehensive testing protocol to assess the hazard of an uncontrolled hazardous waste site". 1987-89. Funded by Environmental Protection Agency for \$315,897.
- "Evaluation of the Bacterial Mutagenicity and Chemical Characteristics of Municipal Landfill Leachate". 1988-1990. Sponsored by Texas Water Resource Institute, \$47,500.
- "Bioassay Directed Chemical Characterization of Hazardous Organic Chemicals in Waste Contaminated Environments". Funded by National Institute of Health, 1989-1992, \$422,000.
- "The Use of Short-Term Bioassays to Assess the Human Health Hazard of Uncontrolled Hazardous Waste Sites". Funded by National Institute of Health, 1989-1992, \$607,000.
- "In Situ Bioremediation of Hazardous Substances in the Vadose Zone". Funded by USEPA, 1988-1991, \$341,164.

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"Effectiveness of Multiple Liner Systems for Hazardous Waste Containment Facilities". Funded by USEPA, 1988-1991, \$387,203.

"The Use of In-Vessel Composting as a Treatment Technology for Hazardous Waste Minimization". Funded by Gulf Coast Hazardous Substance Research Center, June 1, 1991-April 30, 1994, \$107,471.

"Site Assessment." Funded by NIH for \$334,650 for first 3 years. 1992-1996.

"Demonstration of the Degradation of Toxic Organics in Composted Municipal Solid Waste." Funded by Texas Water Commission for \$135,000 for two years, 1992-1994.

"A Preliminary Demonstration of the Use of In-Vessel Composting for Degradation of Waste Propellants." Sponsored by Day & Zimmermann, Inc. 1993. Funds amounted to \$18,138.

"Water Use Efficiency and Wetting Patterns Associated with Directed Subsurface Irrigation." Sponsored by Texas-Israel Exchange Program through the Texas Department of agriculture 1995-1996 Funds amount to \$27,770.



## COMPREHENSIVE LISTING OF TESTIMONY BY K. W. BROWN

TRIAL TESTIMONY	DATE
20 Case no. 04-C-296-2; <i>Lenora Perrine, et al., Plaintiffs vs. E.I. DuPont de Nemours and Company, et al., Defendants</i> , in the Circuit Court of Harrison County, West Virginia. This case involved the contamination of homes and properties with metal dust from the former Meadowbrook Smelter in Spelter, West Virginia. Retained by the Plaintiffs.	5/1/06
19 Civil Action No. 95-CV-6400L, <i>Seneca Meadows, Plaintiff vs. ECI Liquidating, et al., Defendants</i> in the United States District Court, Western District of New York. This case involved claims against defendants concerning the disposal of hazardous substances in the Tantalio Landfill, Seneca Falls, New York. Retained by the Plaintiff.	6/21/05 to 6/23/05
18 Civil Action No. 01:01-CV-890; <i>Lyondell Chemical Company, et al., Plaintiffs v. Albemarle Corporation, et al., Defendants</i> in the United States District Court for the Eastern District Of Texas, Beaumont Division. This case involved the disposal of waste containing hazardous substances and groundwater contamination at the Turtle Bayou Superfund in Liberty County, Texas. Retained by ExxonMobil, Defendant.	4/18/05
17 Cause No. 03-001121-CV; <i>Joseph Paul Horlen, et al., Plaintiffs, v. Robert S. Smith and Robo Investments, Inc., Defendants</i> in the District Court of Brazos County, Texas, 361 <sup>st</sup> Judicial District. Case involved the subsurface loss of water from a man-made lake within a residential subdivision and the subsequent undercutting of riverbank along the Brazos River. Retained by the Plaintiffs.	6/17/04
16 Civil Action No. 98-CV-0838S (F); <i>W.R. Grace &amp; Co.-Conn., Plaintiff, V. Zotos International, Inc., Defendant</i> in the United States District Court Western District Of New York. Case involved the disposal of cosmetic waste at the Brewer Road Landfill in Waterloo County, and the contamination of groundwater as a result of these disposal practices. Retained by the Plaintiff.	5/17/04 to 5/21/04
15 Civil Action No. 95-2097 <i>Interfaith Community Organization, et al., Plaintiffs v. Honeywell International, Inc. et al., Defendants</i> . In the United States District Court for the District of New Jersey. This case involved claims against the defendants concerning disposal of chromium waste at the Roosevelt Drive-In Site in Jersey City, New Jersey. Retained by W.R. Grace & Co., W.R. Grace Ltd. and ECARG, Inc., Plaintiffs.	1/28/03 to 1/29/03
14 Case No. 80-1589; <i>United States of America, Plaintiff, vs. City of Philadelphia, Plaintiff-Intervenor, vs. Union Corporation Metal Bank of America, et al., Defendants, vs. Consolidated Edison Company of New York, et al., Third Party Defendants</i> . In the United States District Court for the Eastern District of Pennsylvania. This case involved claims against the defendants concerning the release of PCBs from the Metal Bank/Cottman Avenue Site to the Delaware River. Retained by the Defendants	08/29/02 to 09/05/02

**Comprehensive Listing of Testimony by K. W. Brown**

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| 13 | Civil No. N-87-52 (PCD). <i>The B.F. Goodrich Company, et al., Plaintiffs v. Harold Murtha, et al., Defendants v. Risdon Corporation et al., Third Party Defendants</i> . In the United States District Court, District of Connecticut. Case involved characterization of hazardous substances in waste generated by industries, commercial establishments, and municipalities disposed at two landfills in Connecticut, Beacon Heights Landfills and Laurel Park Landfill, which were classified as Superfund sites. Retained by Plaintiffs Beacon Heights Coalition and Laurel Park Coalition. | 01/05/98 to<br>01/09/98 and<br>01/12/98 to<br>01/13/98 |
| 12 | Docket Nos. CV-96-0564091S and CV-96-0564092S; <i>Oxford Tire Supply, Inc., Plaintiff v. Commissioner of the Department of Revenue Services, Defendant</i> . In the Superior Court, Judicial District of Hartford/New Britain at Hartford, Connecticut. Case involved tax issues associated with handling of hazardous materials as defined by Connecticut tax regulation. Primary area of testimony was leaching of hazardous substances from rubber tire waste. Retained by Plaintiffs.  | 12/18/97   |
| 11 | Civil Action No. 292CV00674(JBA); <i>The Companies for Fair Allocation Group v. Axil Corporation, et al.</i> In the United States District Court for the District of Connecticut. Case involved question of hazardous waste disposal by the Dynamics Corporation of America (Waring Division) at the Barkhamsted-New Hartford Landfill Superfund site in Barkhamsted, Connecticut. Retained by the Plaintiffs.   | 6/13–14/96   |
| 10 | Civil Action No. 93-CV-0090-B; <i>KN Energy, Inc., et al., v. Sinclair Oil Corp., d/b/a/ Little America Refining Co.</i> United States District Court, District of Wyoming. Case involved study of hydrocarbon and metals groundwater plume, which had migrated from the area of a refinery and adjacent terminal to a nearby neighborhood in Wyoming. Work involved study of the origin of the plume. Retained by the Plaintiff.  | 6/6/95   |
| 9  | Cause No. CA-94-CI-05270; <i>John Gibson Trustee v. Exxon Corporation</i> . District Court, 225 <sup>th</sup> Judicial District, Bexar County, Texas. Suit involved claim by property owners adjacent to an old refinery for damages due to contaminant migration onto their property from previous waste disposal operations at the closed refinery. Retained by the Defendant.   | 2/17/95<br>2/21/95                                     |
| 8  | Docket No. N-87-52 (PCD), All Cases; <i>The B.F. Goodrich Company, et al., Plaintiffs v. Harold Murtha, et al., Defendants v. Risdon Corporation et al., Third Party Defendants</i> . United States District Court for the District of Connecticut. Suit concerning the hazardous nature of waste disposed at the Beacon Heights Landfill Superfund site. Retained by the Plaintiff.   | 12/15–19/94  |
| 7  | Case No. 390-37213-SAF-11 and Case No. 390-37214-SAF-11, jointly administered Chapter 11; In re: <i>National Gypsum Company v. Aancor Holdings, Inc.</i> Suit involved groundwater contamination associated with Rolling Knolls Landfill. Retained by the U.S.A.   | 5/18–20/92<br>6/1/92<br>6/24/92                        |
| 6  | Case No. CIV-86-1401-P; <i>The United States of America v. Royal N. Hardage, et al., Advance Chemical Company, et al., v. ABCO, et al.</i> United States District Court for the Western District of Oklahoma. Enforcement of ROD concerning remediation of hazardous waste site. Retained by the Plaintiff.  | 10/27/89   |

### Comprehensive Listing of Testimony by K. W. Brown

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| 5 | <i>The United States of America, the State of New York, and UDC-Love Canal, Inc., v. Occidental Chemical Corp., Occidental Chemical Holding Corp., Occidental Petroleum Investment Co., Occidental Petroleum Corp., City of Niagara Falls, Niagara County Health Department, and the Board of Education of the City of Niagara Falls, Love Canal Landfill Superfund site.</i> United States District Court for the Western District of New York. Testimony on the mobility of organic pollutants through clay. Retained by the Plaintiff. | 3/20–21/89 |
| 4 | Case No. 85-17210-C; <i>James L. Slaughter, et al., v. Farm and Home Savings, et al.</i> , and Case No. 86-48352; <i>Mike Fenimore, et al., v. Farm and Home Savings</i> . 151 <sup>a</sup> Judicial District Court of Harris County, Texas. Case involved issues of land development and exposure to petrochemical wastes by residents in neighborhoods adjacent to the Brio/Dixie Oil Processors Superfund sites (Houston, Texas). Retained by the Plaintiffs.  | 12/6/89    |
| 3 | <i>Barbara Lips v. Jacobs Oil Company.</i> Federal District Court in Corpus Christi. Testimony on the damages and reclamation results from oilfield drilling mud wastes. Retained by the Plaintiff.   | 1985       |
| 2 | <i>Blaire v. Palmer Oil.</i> Texas District Court. Suit over the destruction of land resulting from oil exploration activities. (587091018) Retained by the Plaintiff.  |            |
| 1 | <i>Jarvis L. Smoak v. Arkansas Louisiana Gas Company.</i> In the Texas District Court of Marshall, Texas. Contamination of soil and loss of trees due to oil spill. Retained by the Defendant.  |            |

### Comprehensive Listing of Testimony by K. W. Brown

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#### DEPOSITION TESTIMONY

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| 75 | Case no. 04-C-296-2; <i>Lenora Perrine, et al., Plaintiffs vs. E.I. DuPont de Nemours and Company, et al., Defendants</i> , in the Circuit Court of Harrison County, West Virginia. This case involved the contamination of homes and properties with metal dust from the former Meadowbrook Smelter in Spelter, West Virginia. Retained by the Plaintiffs.  | 1/25-26/06<br><br>2/10/06 |
| 74 | Cause No. 02-4162 JPG; <i>Chevron Environmental Management Company, Chevron Environmental Services Company, and Texaco Inc., Plaintiffs, v. Indian Refining I Limited Partnership (f/k/a Indian Refining Limited Partnership), et al, Defendants</i> in the United States District Court for the Southern District of Illinois. Case involved remediation and allocation of costs for the former Indian refinery in Lawrenceville, IL. Retained by the Plaintiff   | 8/3/05                    |
| 73 | Cause No. 02-4162 JPG; <i>Chevron Environmental Management Company, Chevron Environmental Services Company, and Texaco Inc., Plaintiffs, v. Indian Refining I Limited Partnership (f/k/a Indian Refining Limited Partnership), et al, Defendants</i> in the United States District Court for the Southern District of Illinois. Case involved remediation and allocation of costs for the former Indian refinery in Lawrenceville, IL. Retained by the Plaintiff   | 6/2/05                    |
| 72 | Civil Action No. 95-CV-6400L, <i>Seneca Meadows, Plaintiff vs. ECI Liquidating, et al., Defendants</i> in the United States District Court, Western District of New York. This case involved claims against defendants concerning the disposal of hazardous substances in the Tantalio Landfill, Seneca Falls, New York. Retained by the Plaintiff.  | 5/27/05                   |
| 71 | File No. C7-0310992; <i>State of Minnesota, Plaintiff, v. American Hardware Mutual Insurance Company, Defendants</i> in the District Court of Minnesota, Tenth Judicial District. Case involved the disposal of hazardous substances with industrial waste at Oak Grove and East Bethel Landfills and the contamination of groundwater as a result of these disposal practices. Retained by the Plaintiff.   | 4/21/05                   |
| 70 | Case No. 03-CV-327 (H) M; <i>Betty Jean Cole, et al., Plaintiffs, v. Asarco Incorporated, et al., Defendants</i> in the United States District Court for the Northern District of Oklahoma. Case involved an evaluation of the Tar Creek Superfund site and the subsequent assessment and evaluation of lead contamination and lead transport pathways in the communities of Picher and Cardin, Oklahoma, including the impacts of lead exposure to the children within these communities. Retained by the Plaintiffs. | 12/7/04                   |
| 69 | Civil Action No. 01:01-CV-890; <i>Lyondell Chemical Company, et al., Plaintiffs v. Albemarle Corporation, et al., Defendants</i> in the United States District Court for the Eastern District Of Texas, Beaumont Division. This case involved the disposal of waste containing hazardous substances and groundwater contamination at the Turtle Bayou Superfund in Liberty County, Texas. Retained by ExxonMobil, Defendant.   | 7/8/04                    |

### Comprehensive Listing of Testimony by K. W. Brown

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| 68 | Case No. 03-CV-327 (H) M; <i>Betty Jean Cole, et al., Plaintiffs, v. Asarco Incorporated, et al., Defendants</i> in the United States District Court for the Northern District of Oklahoma. Case involved an evaluation of the Tar Creek Superfund site and the subsequent assessment and evaluation of lead contamination and lead transport pathways in the communities of Picher and Cardin, Oklahoma, including the impacts of lead exposure to the children within these communities. Retained by the Plaintiffs.   | 6/30/04              |
| 67 | Court File No. CT 02-016741; <i>State of Minnesota, by its Attorney General, Mike Hatch, Plaintiff, v. American Hardware Mutual Insurance Co., et al., Defendants</i> in the District Court of Minnesota, Fourth Judicial District. Case involved the disposal of hazardous substances with industrial waste at the WDE and St. Augusta Landfills and the contamination of groundwater as a result of these disposal practices. Retained by the Plaintiff.   | 2/24/04              |
| 66 | Civil Action No. 98-CV-0838S (F); <i>W.R. Grace &amp; Co.-Conn., Plaintiff, V. Zotos International, Inc., Defendant</i> in the United States District Court Western District Of New York. Case involved the disposal of cosmetic waste at the Brewer Road Landfill in Waterloo County, and the contamination of groundwater as a result of these disposal practices. Retained by the Plaintiff.  | 2/12/04              |
| 65 | Case No. 00-01917 MRP (MANx); <i>Shell Chemical Co., et al., Plaintiffs, vs. The County of Los Angeles, et al., Defendants</i> in the United States District Court for the Central District of California; Case No. 00-1938 MRP (MANx); <i>Phillips Petroleum Co., et al., Plaintiffs, vs. The County of Los Angeles, et al., Defendants</i> in the United States District Court for the Central District of California; and Case No. 00-6420 MRP (MANx); <i>Atlantic Richfield Co., et al., Plaintiffs, vs. BKK Corporation, et al., Defendants</i> in the United States District Court for the Central District of California. These combined cases involved hazardous substances associated with municipal solid waste being deposited at Cal Compact Landfill. Retained by the Plaintiffs. | 3/7/03               |
| 64 | Court File No. MC00-001819; <i>State of Minnesota, by its Attorney General, Mike Hatch, Plaintiff, v. Employers Insurance of Wausau, A Mutual Company, et al., Defendants</i> in the District Court of Minnesota, Fourth Judicial District. Case involved the disposal of hazardous substances with industrial waste at the Oak Grove Landfill and East Bethel Landfill in Anoka County, and the contamination of groundwater as a result of these disposal practices. For the Plaintiff.  | 12/17/02             |
| 63 | Case No. 80-1589; <i>United States of America, Plaintiff, vs. City of Philadelphia, Plaintiff-Intervenor, vs. Union Corporation Metal Bank of America, et al., Defendants, vs. Consolidated Edison Company of New York, et al., Third Party Defendants</i> in the United States District Court for the Eastern District of Pennsylvania. This case involved claims against the defendants concerning the release of PCBs from the Metal Bank/Cottman Avenue Site to the Delaware River. Retained by the Defendants   | 5/28/02              |
| 62 | Civil Action No. H-98-0408 <i>United States of America, et al. vs. Atlantic Richfield Company, et al vs. Ashland, Inc., et al.,</i> in the United States District Court Southern District of Texas Houston Division. This case involved claims against defendants concerning waste disposal at Sikes Pit. Retained by the Defendant.   | 6/26/01 -<br>6/27/01 |

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| 61 | Civil Action No. 95-2097 <i>Interfaith Community Organization, et al. v. Honeywell International, Inc. et al.</i> , in the United States District Court for the District of New Jersey. This case involved claims against the defendants concerning disposal of chromium waste at the Roosevelt Drive-In Site in Jersey City, New Jersey. Retained by W.R. Grace & Co., W.R. Grace Ltd. and ECARG, Inc., Defendants.   | 6/20/01              |
| 60 | Civil Action No. 5:97CV00894; <i>United States of America v. Chrysler Corp. et al.</i> , in the in the United States District Court for the Northern District of Ohio. This case involved claims against the defendants concerning disposal of hazardous substances in the Krejci Dump Site. Retained by Minnesota Mining Manufacturing Company, Defendant.  | 06/07/01             |
| 59 | Civil Action No. G-96-493; <i>Janie Rivas, et al., vs. Monsanto Company, et al.</i> , in the United States District Court for the Southern district of Texas Galveston Division. This case involves modeling of emissions and air dispersion of hazardous substances emanating from petrochemical wastes processed and disposed of at the Brio/Dixie Oil Processors Superfund Sites in Houston, Texas and related exposures to children in adjacent neighborhoods. Retained by the Plaintiffs. | 03/16/01             |
| 58 | Case No. CIV-91-2067-PHX-PGR <i>Maurice McIntire, et al. vs. Motorola, Inc.</i> , in the United States District Court in and for the District of Arizona. This case involved a lawsuit by certain Phoenix residents concerning the VOC groundwater and ambient air plumes perpetrated by Motorola and the subsequent exposure of the litigants to the hazardous substances. This deposition involved waste management and waste handling.  | 5/31/00 -<br>6/2/00  |
| 57 | Case No. 98-CV0726 <i>Connie Lolley Klostermann, et al vs. Ultramar Diamond Shamrock Corporation, et al.</i> , in the 212 <sup>th</sup> Judicial District Court, Galveston County, Texas. This case involved a lawsuit by the landowner concerning property damage resulting from leaking storage tank contamination. Retained by Diamond Shamrock, Defendant.   | 5/26/00              |
| 56 | Case No. 97-6222 MRP (MANx) <i>Commercial Realty Projects, Inc., and L.A. Metromall LLC, vs. Atlantic Richfield Company, et al.</i> , in the United States District Court in for the Central District of California. This case involved hazardous substances associated with municipal solid waste being deposited at Cal Compact Landfill. Retained by the Defendants.  | 3/6/00               |
| 55 | Case No. 93-055257 <i>Ralph L. Nichols, Jr., et al. vs. Monsanto Company, et al.</i> , in the 125 <sup>th</sup> Judicial District Court of Harris County, Texas. This case involved contaminant migration via air, surface water, and groundwater media from the Dixie Oil Processors Superfund Site to adjacent athletic field. Retained by the Plaintiffs.   | 1/28/00              |
| 54 | Case No. CIV-91-2067-PHX-PGR <i>Maurice McIntire, et al. vs. Motorola, Inc.</i> , in the United States District Court in and for the District of Arizona. This case involved a lawsuit by certain Phoenix residents concerning the VOC groundwater and ambient air plumes perpetrated by Motorola and the subsequent exposure of the litigants to the hazardous substances.  | 12/6/99 -<br>12/8/99 |
| 53 | Case No. 89-4340 (JBS) <i>United States vs. Helen Kramer et al.</i> , In the United States District Court for the District of New Jersey. This case involved hazardous substance deposition into Kramer Landfill (Superfund Site) by defendants. Retained by lawyers for the plaintiff.  | 10/6/99              |

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| 52 | Case No. 92-034865; <i>James E. Barnet, Sr., et al., vs. Monsanto Company, et al.</i> In the District Court of Harris County, Texas, 80 <sup>th</sup> District Court. This case involved former workers' claims concerning exposure to hazardous chemicals. Retained by the Plaintiffs.  | 4/28/99                            |
| 51 | Case No. 95C-1065; <i>Lemberger Sites Remediation Group, Plaintiff, v. A.M. Richter &amp; Sons Co., et al., and White Consolidated Industries, Inc., Defendants</i> ; In the United States District Court Eastern District of Wisconsin. This case involved hazardous constituents in waste going to Lemberger Landfill (Superfund Site). Retained by the Plaintiff.   | 3/12/99                            |
| 50 | Case No. 98-459-A; <i>Lewie Byers, vs. Texaco Exploration and Production Inc. and Texaco Inc.</i> In the District Court of Smith County, Texas 7 <sup>th</sup> Judicial District. This case involves claims of contamination due to releases of crude oil and fluids from oil field production activities. Retained by the Defendant.  | 1/22/99                            |
| 49 | C.A. No. G-96-493; <i>Janie Rivas, et al., vs. Monsanto Company, et al.; Defendant.</i> In the United States District Court for the Southern district of Texas Galveston Division. This case involves modeling of emissions and air dispersion of hazardous substances emanating from petrochemical wastes processed and disposed of at the Brio/Dixie Oil Processors Superfund Sites in Houston, Texas and related exposures to children in adjacent neighborhoods. Retained by the Plaintiffs.   | 12/30/98                           |
| 48 | Cause No. 95-044151; <i>Rebecca Johnson, et al., and On Behalf of All Those Similarly Situated, Plaintiffs, vs. Exxon Company, U.S.A., et al., Defendant.</i> In the 61 <sup>st</sup> Judicial District Court, Harris County, Texas. Case involved claims of contamination to a neighborhood near Carver Elementary school that was built over covered pits where oil began to surface in 1995. Retained by the Defendant.   | 7/24/98                            |
| 47 | Case 75524; <i>Clarice Friloux, et al., Plaintiffs, vs. Campbell Wells Corporation, et al., Defendants.</i> In the 17 <sup>th</sup> Judicial District Court, Parish of Lafourche, Louisiana. Case involved claims of offsite air migration of hazardous substances purportedly associated with a non-hazardous oilfield waste disposal facility. Retained by the Defendants.   | 5/21/98                            |
| 46 | Case No. 93-004644; <i>Mike Adalis, et. al., Plaintiffs, vs. Neighborhood Development Corporation, et al, Defendants.</i> In the District Court of Harris County, Texas, 269 <sup>th</sup> Judicial District. Case involved claims of groundwater and related drinking water well contamination attributable to 50 year old oil well blowout. Retained by the defendant Exxon.   | 2/13/98 and<br>7/8/98              |
| 45 | Civil Action No. 95-514875-CE; <i>Grand Trunk Western Railroad, Incorporated and Star Oil Company, Inc., Plaintiffs vs. Union Oil Company of California, Wynkoop Oil Company, Clement Wynkoop, Secory Oil Company and Lewis Secory, Defendants and Union Oil Company and Clement Wynkoop, Counter-Plaintiffs/Cross-Plaintiffs vs. Secory Oil Company and Lewis Secory.</i> Case involved modeling of the transport and fate of hydrocarbon fuels, which leaked from storage, tanks at a terminal and allegedly migrated onto adjoining properties of plaintiffs. Retained by the Defendants. | 5/22/97 and<br>6/2/97 to<br>6/3/97 |

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| 44 | Case No. 93-03044, <i>James W. Allen, III and Victoria Ann Allen, et al. Monsanto Company, et. al.</i> , and Case No. 93-14478, Christopher Irwin and Jon H. Moore, et al., in the District Court of Harris County, Texas, 113 <sup>th</sup> Judicial District. Case involved contaminant migration via air, surface water and groundwater media from the Dixie Oil Processors Superfund Site to adjacent children's athletic field. Retained by the Plaintiffs.   | 5/13/97             |
| 43 | Civil Action 96C19S; <i>Junker Landfill v. United Waste</i> . In the U.S. District Court, Western District. Case involved study of hazardous substances in wastes generated by approximately 500 generators taken to Junker Landfill (Superfund Site). Retained by Plaintiffs.   | 2/28/97             |
| 42 | Cause No. A99,534; <i>Joann McKnight Lambert v. Melvin B. Etheredge, et al.</i> In the 70th District Court, Ector County, Texas. Case involved study of subsurface moisture condition and moisture migration through house slab. Retained by Plaintiff, Lambert.   | 1/29/97             |
| 41 | Case No.: 2:92-CV-111; <i>Commercial Union Insurance Co., et. al., v. Cannelton Industries, Inc.</i> , In the United States District Court for the Western District of Michigan. Case involved claim against insurance company for environmental remediation cost recovery associated with chromium contamination of St. Marys River due to a fire at an old tannery plant. Retained by Defendant.   | 9/5/96              |
| 40 | Civil Action No. BC015575; <i>Atlantic Richfield Company and ARCO Chemical Company v. Aetna Casualty and Surety Company of America, et. al.</i> ; Superior Court of the State of California for the County of Los Angeles. Case involved disputed claims for insurance coverage of environmental contamination at old refinery sites at Sand Springs, Oklahoma, and Prewitt, New Mexico. Retained by the Plaintiffs.   | 4/9/96 -<br>4/10/96 |
| 39 | Civil Action No. 92-2-28065-5; <i>Aluminum Company of America and Northwest Alloys, Inc. v. Accident and Casualty Insurance Company, et al.</i> Superior Court of the State of Washington, In and For the County of King. Case involved disputed claims for insurance coverage of environmental contamination at three aluminum-manufacturing facilities across the country, and entailed extensive interpretation of historical aerial photographs of the facilities. Retained by the Plaintiffs.   | 2/5/96              |
| 38 | Civil Action No. 85-17210-G; <i>David L. Smithson et al., v. Monsanto Company, et. al.</i> , District Courts, 11th Judicial District, Harris County, Texas; and Civil Action No. 93-045095; <i>Thuy Thi Diep, et al., v. Monsanto Company, et al.</i> ; District Court, 55 <sup>th</sup> Judicial District, Harris County, Texas. These consolidated cases involved the Brio Superfund Site and exposure of adjacent residents to hazardous chemicals in an old waste disposal site through air, soil, groundwater, surface water and drinking water pathways. Retained by Plaintiffs. | 11/8/95             |
| 37 | Civil Action No. 87-4263(JHR); <i>General Electric Company v. Buzby Brothers Materials Handling Company, et al.</i> United States District Court for the District of New Jersey. Case involved recovery from commercial and municipal transporters of wastes of the costs for remediation of groundwater contamination at the site of the RCA-Buzby Landfill (Superfund Site) near Voorhees, New Jersey. Retained by the Plaintiff.  | 6/13-14/96          |